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ABSTRACT

This report presents the results of a review of all significant instructional efforts in the computer science discipline in Virginia institutions of higher education, with emphasis on those whose instructional activities constitute complete degree programs. The report is based largely on information provided by the institutions in self-studies. A brief overview discusses the computer science discipline and its current and future importance to the Commonwealth. Program offerings as of Fall 1982 are then described for each of the three major fields of the discipline: computer science, management information systems, and data processing. Conclusions and recommendations are presented that relate to both specific programs and the system-wide activity in each field, as well as general conclusions and recommendations concerning the entire computer science discipline. Appendices contain a summary of comments by employer representatives, Computer Science Program Requirements of ACM/IEEE Task Force on Computer Science, curricula of the data processing programs, a chart showing the design of the Virginia Community College Network (VCCN), a description of VCCN academic and administrative support services, charts of the current status of VCCN equipment installation and VCCN systems management design, and several institutional responses to the report. (LMM)

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AN ASSESSMENT OF COMPUTER SCIENCE DEGREE PROGRAMS IN VIRGINIA

A Report to the Council of Higher Education and
Virginia's State-Supported Institutions of Higher Education

by

The Task Force on Computer Science

October 1983

IR011052

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EXECUTIVE SUMMARY

AN ASSESSMENT OF COMPUTER SCIENCE DEGREE PROGRAMS IN VIRGINIA

The demand for qualified professionals in all fields of the computing discipline has expanded rapidly during the past two decades. As American society moves into the high technology environment of the twenty-first century, this demand will continue to grow and will place ever increasing stress upon Virginia's institutions of higher education as they attempt to satisfy manpower needs within the Commonwealth. Because computing programs in Virginia's institutions of higher education are in differing stages of development and diverse in focus and curricular emphasis, their ability to respond to the demands of the high technology society varies greatly.

The assurance of quality and the determination of continued need for academic programs through periodic assessment is of paramount importance to the vitality of the educational endeavor. The institutions of higher education, as the primary guarantors of the quality of their academic programs, and the Council of Higher Education, as the State agency charged with coordinating an effective and efficient system of higher education, have undertaken a year-long assessment of programs in the computing discipline. This evaluation was conducted by a Task Force, composed of academics and representatives of the computing industry, and was enhanced by institutional contributions of self-study evaluations of their programs and other pertinent data and opinion.

Based on its review of the institutional self-studies of programs in the computing discipline as of Fall 1982, the Task Force found that

- Curricula of the programs generally are at an acceptable level, although each of the programs could be improved in specific ways.
- Inadequate computing power, access to computing facilities, and support personnel adversely affect the quality and instructional capabilities of the programs.
- Student enrollments threaten to overwhelm the capacity of faculty and facilities to support the programs, and the lack of program

admission standards to screen for the most qualified applicants exacerbates the continuing pressures of expanding enrollments.

- Faculty qualified by training or experience to teach in the programs are difficult to recruit and retain, and academic salaries and research support generally are not competitive with those in the field.
- Programs often are housed within other disciplines, lacking a clear administrative structure, and their titles are imprecise or misleading.

To strengthen the computing programs in Virginia's state-supported institutions of higher education, the major recommendations of the Task Force are that

- Access to computing facilities be improved to meet a minimum standard of one terminal or microcomputer with appropriate response time for each fifteen students enrolled in any course that requires significant computing assignments.
- Admission standards be developed for screening applicants to the programs, so that the most qualified students are admitted and the limited program resources are not overwhelmed.
- Salary and research support are raised to a competitive level with those in industry and other academic institutions nationally to ensure that qualified faculty can be recruited and retained in the programs.
- Faculty from other disciplines be retrained with the minimum equivalent to a baccalaureate degree in the computing discipline to alleviate the current excessive workloads of the computing faculty.
- Computing programs, no matter where housed, should be administered separately and the program titles should indicate clearly the nature and scope of the curriculum.

The Task Force believes that the computing programs in Virginia's institutions of higher education form a good foundation upon which a systemwide activity of high quality can and will emerge. Although many programmatic aspects need to be improved, many others are sound and indicate the potential for quality. To act on many of the Task Force's recommendations will require high levels of expenditure, and a major investment is required immediately if Virginia is to prepare persons for the high technology society of the twenty-first century.

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PREFACE

The Council of Higher Education, in fulfilling its responsibility to coordinate an effective and efficient system of higher education in Virginia, reviews academic programs in the state-supported institutions of higher education to ensure that they are productive and economical. Concurrently, the Commonwealth Program Budgeting System charges all state agencies, including higher education institutions, with responsibility for evaluating their activities to ensure that State funds are producing promised results.

In extending its productivity reviews to include an assessment of the quality of, and need for, selected academic disciplines or functions, the Council recognizes that Virginia's institutions are the primary guarantors of the quality of their activities. Nevertheless, quality assurance has always been a shared responsibility: the Council (among other central State agencies) makes qualitative judgments in the review of the institutions' curricular plans and operating budgets. In initiating a shared process for quality assessment, the Council has built upon existing evaluation practices. The individual institutions will continue to have primary responsibility for program accreditation and for campus-level program review and evaluation. The Council will focus on broad-scale program or function evaluations within a system-wide context.

A Task Force on Computer Science was appointed by the Council of Higher Education, acting in consultation with its Instructional Programs Advisory Committee. This Task Force was composed of faculty and administrators in computer science and other disciplines and representatives from major employers of computer science professionals in both the public and private sectors. The Task Force was co-chaired by a Task Force member appointed by the Council and by a non-voting member of the Council staff.

The Task Force on Computer Science was charged with reviewing all significant instructional efforts in the computer science discipline, whether housed in specific degree programs or contained in parallel disciplines such as Mathematics or Business Administration. Excluded from review were programs or activities whose major emphasis is the design of computer hardware, and the review of institutional computer centers was limited to only that extent to which the centers support the academic programs in the discipline. During the course of its investigations, the Task Force further limited the scope of the assessment to exclude those institutions whose instructional activities in the discipline constitute less than complete degree programs.

The assessment was based in large measure upon information provided by the institutions in self-studies that followed guidelines developed by the Task Force. During its review of these self-studies, the Task Force divided into three groups to consider the programmatic offerings in the fields of computer science, management information systems, and data processing. The three groups sought additional data by which to clarify or expand that contained in the self-studies, and further limited the scope of their investigations according to the availability of necessary data. The findings and recommendations of each group were then reviewed and approved by the full Task Force.

Chapter 1 presents a brief overview of the computer science discipline and discusses its current and future importance to the Commonwealth. Chapters 2 through 4 describe program offerings as of Fall 1982 in each of the three major fields of the computer science discipline and present conclusions and recommendations relating to both specific programs and the system-wide activity in each field. General conclusions and recommendations relating to the entire computer science discipline are presented in Chapter 5. Appendices contain additional information and several institutional responses to the report.

The Task Force received much assistance during its activities. Thirty-one representatives of employers of computer science professionals shared with the Task Force their assessments of the graduates from Virginia's programs, speaking both to the quality of current graduates and the projected need for future graduates. Their comments are summarized in Appendix I. The Task Force expresses grateful thanks to:

C. D. Avers, IBM Corporation, Manassas
William Bell, Virginia Department of Management Analysis and Systems Development, Richmond
Steve Bromet, Best Products Company, Inc., Richmond
Douglas Carneal, Newport News Shipbuilding and Dry Dock Company, Inc., Newport News
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Walter Waleski, Media General Incorporated, Richmond
Eileen Ward, First and Merchants National Bank, Richmond
Larry Wons, AT&T Long Lines, Oakton
Tom Zakrzewski, Flow General, Inc., McLean

This assessment of the computer science discipline could not have been undertaken or completed without the cooperation of Virginia's institutions of higher education. The support of the institutions' chief academic officers and the unstinting efforts of the institutional self-study committees have been crucial to the success of this activity. The assistance received by the Task Force from the institutions demonstrates a commitment to both the concept of peer-group evaluation and the quest for quality in higher education. The Task Force thanks the faculty members and administrators of the institutions that participated in this study.

This has not been an easy study to conduct. Not only are a large number of institutions involved in computer science education, but the discipline is sufficiently broad and dynamic to encompass a wide variety of approaches and viewpoints. Both the institutions and the Task Force labored under severe time constraints, and the schedule imposed by the Task Force upon its activities, to permit adequate review of the report in draft form by the institutions, necessitated the timely completion of the self-studies and the writing of preliminary and draft chapters. Moreover, because this study was one of the three first evaluations to be undertaken by the Council and the institutions, the entire study has been viewed with some apprehension by many concerned with its outcome.

The Task Force is well aware of the limitations of this assessment. The study focused only on those state-supported institutions that offer degree programs in the computer science discipline; courses offered as part of other curricula generally are not addressed, and the sizeable activities of Virginia's private institutions are likewise excluded. Computer science is a rapidly changing discipline and the Task Force recognizes that the conditions portrayed by the program descriptions and accompanying data tables, while accurate as of Fall 1982, may have changed dramatically since that time. Nevertheless, the Task Force believes that its findings support its conclusions and recommendations.

CHAPTER 1

INTRODUCTION

Virginia's institutions of higher education are faced with a major challenge to meet the demand for computing education. High school and college students are clamoring for computer-related education. Parents, teachers, career advisors, journalists, and even television advertisers are pressuring today's students to obtain good computing knowledge.

Virginia's institutions are not alone in facing this challenge. Nationally, the demand for computing education exceeds supply. Although the number of systems analysts and programmers increased by 150 percent during the 1970's, the demand is expected to double by 1990.<1> Even though their financial resources are not increasing significantly, the institutions are scrambling to acquire the resources to meet their individual perceptions of the demand for computing education. It is apparent from the institutions' self-studies that their approaches to reaching their goals for computing education are diverse.

One of the difficulties facing educational institutions is to define the objectives for computer-related instructional activities. Computing instruction may be part of the general offerings that provide a liberal education to the student body. Computer science may be considered one discipline within the total curricular offerings of the institution. Finally, specific programs may focus upon particular computational products and their usage and maintenance in order to produce students who are qualified to enter the job market with

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<1>U. S. Bureau of Labor Statistics, "Employment Trend in Computer Operations," Bulletin of the Bureau of Labor Statistics, No. 2101 (October 1981), 1.

immediately applicable skills. All these objectives are addressed within Virginia's comprehensive system of higher education, although every objective may not be found within each program addressed in this study.

Instruction and research are supported by three fields of the computing discipline in Virginia's state-supported institutions of higher education.<2> The largest of these fields, in number of degree programs, is computer science. Eleven institutions offer academic programs in computer science at levels ranging from the bacclaureate to the doctorate. These computer science programs have been described as providing "a thorough grounding in the study of the implementation of algorithms in programming languages which operate on data structures in the environment of hardware."<3> A typical high-quality undergraduate program includes concentrated studies of mathematics and its application to computing, algorithms, data structures, programming concepts and languages, computer hardware elements, and computer architecture.<4>

Programs in management information systems are offered at the bachelor's and master's levels in six Virginia institutions. These programs involve significant study of information systems technology, systems concepts and processes, and organizational functions and management.

Two-year associate degree programs in data processing are offered by twelve community colleges. These programs include instruction in the uses and

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<2>Those fields of the computer science discipline that deal with computer engineering (the design of computer hardware) are excluded from this study.

<3>R. Austing, B. H. Barnes, D. T. Bonnette, G. L. Engel, and G. Stokes (Eds.), "Curriculum '78: Recommendations for the Undergraduate Program in Computer Science," Communications of the ACM 22, 3 (March 1979), 147-165.

<4>T. Cain, G. L. Engel, G. Davida, N. Gibbs, T. Frederick, J. Dalphin, and M. Mulder, "Computer Science Program Requirements." Unpublished draft position paper of the Joint ACM/IEEE Task Force for Computer Science Program Accreditation, January 1983.

operation of systems in administrative applications and typically include some exposure to accounting and management topics.

The rapid extension of computer processing usage to areas of business, industry, government, and academe has outpaced the capability to track and quantify the market demand for computing-related education. There are gross estimates of the demand for those graduates whose education is directed toward professional employment in computer related fields such as teaching and research, management, analysis, systems and applications programming and operations. Nevertheless, 1978-1979 estimates<5> clearly indicated a demand which exceeded the supply for persons holding the baccalaureate or higher degree. Only at the associate degree level and below was the projected need being satisfied (Table 1).

TABLE 1--Estimated Annual Need and Production of Computer-Related Degree Holders

Degree Level	United States		Virginia	
	Demand	Production	Demand	Production
Postsecondary, Associate	23,766	32,780	686	675
Bachelor	53,243	14,964	1,413	185
Master's	33,488	3,470	888	55
Doctorate	1,304	326	34	10

Source: Hamblen, Computer Manpower, 16-17.

A 1982 U. S. Department of Defense report indicated that "the United States gap between demand and suppy is measured in terms of 50,000 to 100,000 software professionals ... this gap will grow to 860,000 to 1,000,000 by 1990."<6> These

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<5>J. W. Hamblen, Computer Manpower Supply and Demand by States 1981. St. James, Missouri: Information Systems Consultants, pp. 16-17.

<6>L. E. Druffel, Strategy for a DoD Software Initiative. Washington, D.C.: U. S. Department of Defense, OUSD (R&E), October 1, 1982.

data reaffirm the earlier projections, and, of greater significance, indicate that the nation is losing ground to this growing demand.

Regardless of the absolute magnitude of available estimates, the message is clear. There are extensive employment opportunities for graduates in the computer science discipline and other disciplines that incorporate computing education. This situation can be expected to continue for the forseeable future as computer usage expands the demand for computer literacy to untapped markets.

The nationwide growth and development of computer-related programs has caused serious growing pains, among which are a shortage of equipment, an abundance of potential students coupled with a serious undersupply of qualified faculty, and inadequate support facilities.

Computer-related programs, by their very nature, are equipment-intensive. Computer science educators have emphasized the continuous need to update computing equipment in academic research laboratories in order to cope with an industry whose products have a half-life of five years.<7> Moreover, although enrollments in the discipline have doubled during the past decade, budgets for equipment have increased only marginally, and these conditions have adverse implications for the instructional missions of the institutions.<8>

While institutions are being inundated by applications for admission to programs and courses in the computer science discipline, the supply of qualified faculty in the discipline is critically low. This dichotomous relationship, as

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<7>J. A. Feldman and W. R. Sutherland, "Rejuvenating Experimental Computer Science," Communications of the ACM 22, 9 (September 1979), 497-502.
D. D. McCracken, P. J. Denning, and D. H. Brandin, "An ACM Executive Committee Position on the Crisis in Experimental Computer Science," Communications of the ACM 22, 9 (September 1979), 503-504.

<8>P. J. Denning, "A Discipline in Crisis," Communications of the ACM 24, 6 (June 1981), 370-374.

found in Virginia, is presented in the following chapters.

The reasons for the national shortfall in qualified faculty are many. Perhaps the most important is the attractiveness of private sector positions that often offer high salaries, increased research opportunities and autonomy of action. The perception that the academic institutions are unresponsive to their problems has been identified as a primary motivation for faculty exodus from academe, while new graduates in the discipline believe more adequate research and personal development opportunities are offered by industry than by institutions of higher education.<9> Other problems include excessive teaching and advising loads, together with tenure and promotion procedures which tend to mitigate against the best interests of newer faculty.

Like those in any other academic discipline, programs in computer science need support in terms of library collections and classroom, laboratory, and office space, but as a recently established discipline, these programs have little history upon which to justify requests for these resources. Moreover, institutional administrations understandably are reluctant to transfer resources from established programs to foster new growth, and academic libraries have been loath to acquire materials in the discipline due to their ephemerial nature and rapid replacement cycles.

The future development of strong programs in computer-related fields clearly will require innovative solutions to the challenges faced by computing education in Virginia. But help is needed! The national attention on computing education is drawing educators, industry, and government together to meet the challenge. Resources need to be reallocated. Grants, contributions,

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<9>G. L. Engel and B. H. Barnes, "Employment Decisions by Computer Science Faculty: A summary of the 1980-81 NSF Survey," SIGCSE Bulletin, 14, 1 (February 1982), 167-169.

assistance, and public support must be increased. Furthermore, a statewide direction is required. Virginia's programs in the computer science discipline must be ready and able to respond to the information management requirements of the high technology society of the twenty-first century.

CHAPTER 2

COMPUTER SCIENCE PROGRAMS

Introduction

The Computer Science Field

Academic programs in computer science have been in existence for less than twenty-five years. In this brief period the programs have grown from a few specialized graduate tracks offered by departments of mathematics and departments of electrical engineering to a position currently where they represent one of the largest bases of student enrollments in colleges and universities in the United States. It is estimated that there were 208 bachelor level degree programs administered by departments of computer science in academic year 1978-79 (as opposed to approximately 37 in 1966-67). In addition an estimated 134 bachelor level programs in computer science existed in 1978-79 within departments of electrial engineering, departments of mathematics, and the like. During this same academic year, there were nationally an estimated 160 master's degree programs and 74 doctoral programs in computer science.<1>

As would be expected with a new field, especially one which is interdisciplinary by nature, a definition of computer science is somewhat elusive. The professional societies have been most helpful in this area by promulgating model curricula in the field. While these are not intended to be blueprints for programs, they do represent collections of topics and areas for which there is considerable agreement regarding their importance to the field. No careful

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<1>John W. Hamblen, Computer Manpower, pp. 2-3.

study of programs can ignore these reports, and the interested reader is referred to the 1968<2> and 1978<3> reports of the Association for Computing Machinery (ACM) dealing primarily with undergraduate programs, the 1977 report of the IEEE Computer Society (IEEE/CS)<4> dealing independently with the undergraduate curriculum but containing remarkably similar recommendations to those of the ACM in 1978, and the 1981 report of the ACM<5> dealing with master's level programs. Additional references on curriculum matters in computer science are available for those desiring further background material.<6>

One of the clearer descriptions of the nature of the field appears in the discussion of elementary material in "Curriculum '78": ". . . computer science majors must be given a thorough grounding in the study of the implementation of algorithms in programming languages which operate on data structures in the environment of hardware." The basic nature of the curriculum is also expressed in the draft minimum guidelines for programs in computer science of the joint ACM IEEE/CS Committee on accreditation:<7>

<2>Curriculum Committee on Computer Science (C3S), "Curriculum '68: Recommendations for Academic Programs in Computer Science," Communications of the ACM 11, 3 (March 1968), 151-197.

<3>R. Austing et al. (Eds.), "Curriculum '78," 147-165.

<4>Education Committee (Model Curriculum Subcommittee) of the IEEE Computer Society, A Curriculum in Computer Science and Engineering. Committee Report, IEEE Pub. EHO119-8. Piscataway, N. J., 1977.

<5>R. Austing, A. Berztiss, G. L. Engel, J. W. Hamblen, A. A. J. Hoffman, K. I. Magel, and R. Mathis (Eds.), "Recommendations for Master's Level Programs in Computer Science," Communications of the ACM 24, 3 (March 1981), 115-123.

<6>R. H. Austing, B. H. Barnes, and G. L. Engel, "A Survey of the Literature in Computer Science Education Science Curriculum '68," Communications of the ACM 20, 1 (January 1977), 13-21.
G. L. Engel, "Literature Resources Relating to Computer Science Education in Small Colleges," Proceedings: The Computer, Extension of the Human Mind. Eugene, Oregon: ERIC Clearinghouse on Educational Management, 1982.

<7>T. Cain et al., "Computer Science Program Requirements." (Appendix II).

> The computer science segment of the program (approximately 1.5 years of study) should consist of a broadly based core of from 40% to 60% of the computer science requirements whose emphasis is evenly spread over the areas of computer theory, algorithm, data structures, programming concepts and languages, and computer elements and architecture. Within this portion of the program, emphasis is to be placed on analysis and design work with laboratory experiences receiving a strong emphasis. In addition the student needs to gain exposure to a variety of programming languages and systems, and become proficient in at least one high-level structured language. The social implications of computing should be included in the program.
>
> The remaining 40% to 60% of the computer science segment of the program should be advanced courses in computer science. These courses are to be selected in such a manner to ensure that depth of knowledge is obtained in at least half of the core material.

Among other requirements, the draft guidelines specify a year of study in the supporting disciplines of mathematics and the physical and engineering sciences.

What emerges is that computer science is a rich and varied field. There is a strong theoretical component which borders on abstract mathematics; there is a strong design component that is reminiscent of several engineering disciplines; and there is a strong empirical component which is not unlike some of the physical sciences. In addition, the pervasive nature of computer science requires serious consideration of ethical and social issues. Computer science is clearly a separate and unique area of study with its own laboratories, theory, and practice.

The rapid growth and development of computer science has not come without its share of growing pains, and few programs exist today that do not have significant problems. These problems are made all the more difficult by the fact that computer science is one of the few rapidly growing fields during a period in which resources for higher education are contracting.

Among the problems that face computer science programs nationally are issues of adequate laboratory and research facilities, adequate library resources, faculty issues such as salaries and policies of the institutions, availability of adequately trained faculty, and wildly expanding enrollments both in the major programs and in supporting service programs. The following sections discuss the manner in which the computer science programs in Virginia have dealt, and must deal, with these problems.

Employment Opportunities in Computer Science

Definitive statistics regarding employment opportunities and availability of personnel in computer science have been elusive. The diversity of the field has made it difficult to differentiate the need for a computer scientist versus an educated user. Moreover, entry into the field has followed a variety of tracks with few practitioners having a degree in the field. These circumstances have led Hamblen to conclude that "the cause of many of the problems associated with computer usage is the overutilization of under-educated people."<8>

The positions in computing in the United States have been roughly classified into the following categories:<9>

Teaching and Research
Management
Analysts
Systems Programmers
Applications Programmers
Operators
Other Operating Personnel

While these categories apply to the graduates of virtually all computer related degree programs, graduates at the bachelor's level tend to move into positions of analysts, systems programmers, and applications programmers. Graduates at the master's level tend to move into positions of systems programmers, analysts, or management positions. Graduates with a doctorate tend to move into positions

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<8>Hamblen, Computer Manpower, preface.

<9>Ibid., 8.

in management or teaching and research.<10>

In 1981 Hamblen estimated the need for computer related degree holders in the United States and in Virginia (Table 1). These estimates represented all computer related degree programs including information systems, data processing, and so forth. Of the estimated production of graduates in the entire discipline, the computer science field accounted for approximately 72% at the bachelor's level, 76% at the master's level, and 76% at the doctoral level.<11> It is clear that in 1978-79 Virginia was producing less than its share of bachelor and master's graduates in computer science, when compared to the nation as a whole.

Supply and demand data indicate a clear need for college and university trained computer scientists in Virginia. As will be seen in the next section, the number of undergraduate programs in Virginia has increased considerably in the 1980's, but production of bachelor degree holders in 1982 still only represented 21% of the 1978-79 demand. At the master's level only 10% of the 1978-79 demand was produced by Virginia institutions, and at the doctoral level there has been a decrease with only 8% of the demand produced in Virginia in 1982. The employment prospects for graduates of computer science programs in Virginia for the forseeable future appear to be very good. This prognosis has been confirmed in meetings of the Task Force with representatives of Virginia employers of computing professionals.

Computer Science Programs in Virginia

This section presents quantitative data regarding computer science programs in Virginia.

<10>*Idem*.

<11>*Ibid*., 5.

Computer science programs are offered by 11 state institutions (Table 2). All eleven offer bachelor degree programs, six offer master's degree programs, and three offer doctoral programs. The programs are housed in several types of departments. More than half of the bachelor's degree programs were initiated in or after 1980.

The oldest computer science program in the state is the Ph. D. program at the University of Virginia, which was initiated in 1965. This followed by just four years the first computer science program in the nation, a doctoral program initiated in 1961 within the Department of Electrical Engineering at the University of Pennsylvania. The first computer science department nationally was established in October 1962 at Purdue University.

Table 3 indicates the number of degrees awarded during 1981-82. These figures fall well below the projected demand for computer scientists in Virginia in 1978-79 as given above (Table 1). To meet these levels, the bachelor's degree programs would have to average 93 graduates per institution, the master's programs 113 graduates, and the doctoral programs 9 graduates.

Table 4 presents the number of majors enrolled by level in Fall 1982 at each of the institutions. At the undergraduate level the division of part-time and full-time students follows expected lines with regard to the predominantly residentual campuses as opposed to the predominantly commuter campuses. The majority of master's students are part-time, indicating that many of these students are pursuing their studies while employed.

The number of majors provides one measure of student loads; another measure is headcount enrollments, and these data, for Fall 1982, are shown in Table 5. The high enrollments in the lower-level undergraduate and service courses demonstrate the popularity of the field even for those not majoring in it. This also indicates that enrollments may be expected to remain high for the

TABLE 2--Computer Science Programs in Virginia State-Supported Institutions, Fall 1982

Institution	Date Begun	Degree	Department Housing Program
Chr. Newport	1982	BS in Computer Science	Computer Science
George Mason	1980	BS in Computer Science	Mathematical Sciences
	1982	MS in Computer Science	Mathematical Sciences
James Madison	1980	BS in Computer Science	Math. and Computer Sci.
Mary Washington	1980	Computer and Info. Sci.	Math. Sciences and Physics
Norfolk State	1982	BS in Computer Science	Mathematics
Old Dominion	1973	BS in Computer Science	Computer Science
	1980	MS in Computer Science	Computer Science
	1981	Ph.D. in Computational and Applied Math.	Mathematics, Computer Science (joint admin.)
Radford	1982	BS in Computer Science	Math., Stats., & Comp. Sci.
University of Va.	1975	BS in Computer Science	Applied Math. & Comp. Sci.
	1966	MCS-MS in Computer Sci.	Applied Math. & Comp. Sci.
	1965	Ph.D. in Computer Sci.	Applied Math. & Comp. Sci.
Va. Commonwealth	1976	BS in Mathematical Sci. (Computer Science Track)	Mathematical Sci.
	1976	MS in Mathematical Sci. (Computer Science Track)	Mathematical Sci.
Virginia Tech	1970	BS in Computer Science	Computer Science
	1972	MS in Computer Science and Applications	Computer Science
	1974	Ph.D. in Computer Sci. and Applications	Computer Science
William and Mary	1977	AB-BS in Computer Sci.	Math. and Computer Sci.
	1970	MS in Applied Science	Applied Science

TABLE 3--Degrees Awarded in Computer Science Programs, 1981-1982

Institution	Degree Level		
	Bachelor's	Master's	Doctoral
Christopher Newport College	0*		
George Mason University	1*	0*	
James Madison University	6*		
Mary Washington College<1>	1*		
Norfolk State University<2>	0*		
Old Dominion University	47	14*	0*
Radford University	0*		
University of Virginia	33	25	2
Virginia Commonwealth University	17	1	
Virginia Tech	76	18	0
College of William and Mary	29	9	
Total	210	67	2

*New program initiated in 1980, 1981, or 1982.

<1>Bachelor of General Studies, with a "core area" in computer science; a degree for non-traditional students as opposed to the B. S. degree.

<2>Although a new program, 7 graduates in 1981-1982 with a degree in Mathematics, emphasis in computer science.

TABLE 4--Headcount Number of Computer Science Majors Enrolled, Fall 1982

Institution	Undergraduate		Master's		Doctoral	
	Full-Time	Part-Time	Full-Time	Part-Time	Full-Time	Part-Time
Christopher Newport	223	202				
George Mason	316	139	1	18		
James Madison	359	6				
Mary Washington	60	32				
Norfolk State	225	9				
Old Dominion	315	38	53	87		
Radford	116					
University of Va.	144		54	18	9	6
Va. Commonwealth	169*	74*	18	22		
Virginia Tech	611	23	45	93	15	5
William and Mary	100		14	45		
Total	2,638	523	185	283	24	11

*Includes 4 Full-Time and 15 Part-Time enrollments in the post-baccalaureate certificate program.

Note: The criteria for declaring an undergraduate major varies from institution to institution. As a result, the numbers may not be directly comparable.

TABLE 5—Total Headcount Enrollments in Computer Science, Fall 1982

Institution	Lower Level Undergraduate	Upper Level Undergraduate	Graduate	Service Courses
Christopher Newport College	561	230	NA	NS
George Mason University	413	195	48	335
James Madison University	164	136	NA	353
Mary Washington College	107	175	NA	111
Norfolk State University	323	334	NA	291
Old Dominion University	1,252	878	274	634
Radford University*	216	24	NA	256
University of Virginia	71	376	191	863
Virginia Commonwealth Univ.	348	84	103	111
Virginia Tech*	742	515	170	871
College of William and Mary	242	123	62	0
Total	4,439	3,071	848	3,825

NA: Not applicable.
NS: Information not submitted by the institution in the self-study.
*Quarter system.

forseeable future, even if limitations are placed on the actual number of majors.

Table 6 shows the number of faculty teaching in the programs during Fall 1982. An unusually large portion of the faculty are assistant professors, and few of the faculty hold a terminal degree in computer science. This may be due to the fact that more senior faculty probably received their degrees when computer science departments did not exist, but it also may be due to persons holding the terminal degree in computer science not being available, thereby causing institutions to use other criteria for selecting faculty. Although the general use of adjunct and part-time faculty is reasonable, at some institutions such persons are carrying more than the 20% of instructional load that is suggested as a maximmm in the draft ACM IEEE/CS guidelines. It is also significant that most of these departments are quite small, indicating potentially serious problems in continuing the programs should one or two faculty members decide to leave.

TABLE 6--Faculty Teaching in Computer Science Programs, Fall 1982

Institution	Full-Time Appointments						Adjunct or Part-Time
	Prof.	Assoc. Prof.	Asst. Prof.	Instr.	Total	Number Tenured	
Chr. Newport	0 (0)	3 (2)	1 (1)	1	5	2	3
George Mason	0 (0)	3 (1)	2 (0)	1	6	2	8
James Madison	1 (0)	0 (0)	4 (2)	0	5	2	3
M. Washington	1 (0)	1 (0)	1 (0)	1 <1>	4	0	7
Norfolk State	1 (0)	2 (0)	1 (0)	2	6	4	2
Old Dom.<2>	3 (2)	3 (3)	6 (2)	2	14	4	5
Radford<3>	0 (0)	0 (0)	0 (0)	0	0	1 <4>	8
Univ. of Va.	2 (1)	2 (1)	8 (6)	0	12	3	2
V. C. U.	0 (0)	4 (0)	6 (3)	0	10	5 <5>	3
Va. Tech	3 (0)	8 (5)	4 (3)	2	17	11	6
Wm. & Mary	2 (0)	6 (2)	0 (0)	0	8	7	2
Total	13 (3)	32 (14)	33 (17)	9	87	41	49

Note: Numbers in parentheses indicate total of regular faculty with terminal degree in computer science or closely-related field.

<1>Visiting Lecturer.

<2>One Associate Professor on leave of absence, 1982-1983.

<3>All Radford faculty are involved in other activities besides teaching in the computer science program. Two are involved with the computer center (one 1/2-time, one 3/4-time), and the remainder teach at least one-half load in mathematics. Three (including the two who work in the computer center) are listed listed as qualified to teach all computer science courses.

<4>One of the three faculty listed as qualified to teach all computer science courses is tenured.

<5>None of the three faculty with the terminal degree in computer science is tenured.

Average salaries, by rank, are shown in Table 7. A number of the problems experienced nationally with salaries in computer science departments are seen here. There is a problem of requiring ever-increasing salaries to attract new faculty, while finding it difficult to provide existing faculty with significant raises. Moreover, the salary range for assistant professors is about that for a new bachelor's degree graduate in industry, and the range for associate professors is about that for a new master's degree graduate in industry.

Budget and library expenditure data for the programs are shown in Table 8. Care must be used in reviewing these figures. Equipment costs often reflect a

TABLE 7--Academic Yearly Salary Averages by Rank for Faculty in Computer Science Programs, 1981-1982

Institution	Faculty Rank				
	Professor	Associate Professor	Assistant Professor	Instructor	Adjunct (Per Course)
Christopher Newport	NA	24,625	20,955	18,800	1,072
George Mason University	NA	31,900	23,150	16,150	1,200
James Madison University	29,300	NA	25,500	NA	1,575
Mary Washington College	25,232	24,037	19,000	1> 14,500	1,550
Norfolk State University	28,000	24,100	18,700	19,200	945
Old Dominion University	34,000	29,167	23,350	19,600	895
Radford University<2>	NA	24,077	21,375	NA	NA
University of Virginia	40,000	35,000	27,000	NA	3,000
Virginia Commonwealth	NA	24,462	23,025	NA	1,242
Virginia Tech	42,162	30,520	25,850	18,750	1,700
College of William & Mary	34,736	30,310	24,000	24,000	2,200
Average	35,681	28,682	24,036	17,306	

NA: Not applicable.
<1>Visiting Lecturer.
<2>Includes entire mathematics and computer science faculty.

TABLE 8--Computer Science Program Budgets and Library Expenditures

Institution	Expenditure Categories							
	Faculty & Staff Salaries	Student Support	Equip-ment	Travel	Other	Central Computing Support	Total	Library Expend-itures
Chr. Newport	135633	2335	1738	893	2384	116525	259508	2581
George Mason	241355	24000	5000	1500	5000	352200	629055	14100
James Madison	141900	2800	60000	1100	25000	184900	415700	8500
Mary Washington	82853	0	0	450	1500	53039	137842	1396
Norfolk State	190000	3375	5000	5610	4100	70000	278085	15000
Old Dominion<1>	250998	37500	155824	2561	23604	588200	1058687	27251
Radford	207000	9380	*70560	600	1750	38700	327990	1500
Univ. of Va.<2>	337375	202056	4080	11480	57184	190093	802268	7000
V. C. U.<3>	181200	17600	*67800	2200	3865	157532	430197	33000
Virginia Tech<4>	589822	254077	24753	15062	389761	846848	2120323	13500
William & Mary	100633	10600	15000	1800	0	215000	343033	4900

<1>Includes $14,000 in grant and contract funds.

<2>Approximately 30% of the budget from external research funds and 5% from local funds and research overhead.

<3>Includes $111,915 in grant funds and gifts.

<4>Includes $414,091 in grant and contract funds.

*Includes a special one-time purchase.

one-time purchase for the program, and central computing support reflects a variety of charging mechanisms and procedures that may result in this cost being either understated or overstated. Of particular concern are the low levels of support for travel, in an area where professional growth and development are essential, and the low level of library support in several of the institutions where collections must be developed to support this new field.

General Assessment of the Programs

This section assesses computer science programs on a statewide basis. Although the differences in mission and nature of the institutions require that there be certain differences in programs, there is enough common ground in the individual self-studies to warrant a discussion of these areas.

Assessment of the programs was based primarily on the guidelines in the ACM IEEE/CS draft position paper on computer science program requirements (Appendix II). Since these guidelines address undergraduate programs, appropriate adjustments were made by the Task Force in reviewing the graduate programs. Furthermore, the Task Force used the judgment of its members in determining whether the institutions, as reported in their self-studies, met the "spirit" of the guidelines even if they did not meet the letter of the detailed individual requirements.

The general areas considered in all of the assessments were the following:

- Curriculum
  - Computer Science Core
  - Computer Science Electives
  - Mathematics
  - Sciences

- Facilities
  - Central Facilities
  - Micro-computer Access
  - Publicly Available Terminals
  - Software Support
  - Support Personnel
  - Research Facilities

- Faculty
  - Number of Full-Time Faculty
  - Number of Faculty Capable of Teaching All Courses in the Undergraduate Curriculum
  - Number of Faculty with Terminal Degree in Computer Sciences
  - Number of Faculty Professionally Active

- Faculty Concerns
  - Teaching Loads
  - Salaries
  - Professional Development and Leave Programs

- Other Concerns
  - Quality of Students
  - Administration of the Program
  - Library Resources

A program was rated acceptable in a category if, in the judgment of the members of the Task Force, it met the spirit of the ACM IEEE/CS guidelines in a particular area. When the level was exceeded, the program was acknowledged as being good. When the level was not met, the program was rated as weak.

The area of facilities required some adjustment from the rather general statements of the draft guidelines. Specifically, in the judgment of the Task Force a ratio of one terminal (or micro-computer) per 15 students enrolled in a course when significant computing homework is assigned was necessary for a program to have acceptable access to computing facilities.

Curriculum

The undergraduate programs within the state overall are fair. The core requirements typically approximate those of "Curriculum ´78".<12> However, there is typically less required work in computer science. Computer science advanced level electives typically are less available than is desirable. Industry seeks improved student awareness of large systems concepts as a necesssary component.

<12>R. Austing et al. (Eds.), "Curriculum ´78," 147-165.

All of these circumstances are due to the fact that the programs are operating with minimal faculty and facilities.

Supporting requirements in mathematics and science are generally acceptable. Conversely, computing support to other programs is deficient according to the employer representatives.

Graduate programs generally are acceptable. The doctoral programs, as is appropriate, are well directed into current research problems. The master's programs address several different audiences and for the most part appear to cover an appropriate level of both breadth and depth of study in the field. In addition, most programs require a unifying experience, fully meeting the spirit of the master's level recommendations of the Association for Computing Machinery.<13>

Facilities

There is a severe shortage of computing equipment for use by students in homework assignments, individual projects, and research. There are deficiencies in the computational power available for student use and in the provision of access to computing resources through publicly available terminals. Moreover, the academic computing centers generally are inadequately staffed. It is commonplace, even in Virginia's best equipped institutions, for students to wait several hours to gain access to a terminal or to a computer, and not uncommon to see students having to work all night to be certain that they can obtain needed access.

Quality education in computer science requires access to a comprehensive range of modern computing resources which are supported by an adequate

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<13>R. Austirg _et al._ (Eds.), "Recommendations for Master's Level Programs in Computer Science," 115-123.

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professional staff. While there are acceptable mainframe computers throughout the state, access to them usually is inadequate. Mini-computers seem to be well available, serving as the primary support to most of the programs. Access to micro-computers for laboratory work typically is poor. The number of publicly available terminals is low, although there is a great deal of variation among the institutions. When the requirements for service courses and courses in other disciplines are also considered, computing equipment and publicly available terminals are in desperately short supply. Overall, there is little professional help available on the campuses for the users of educational computing.

Throughout the self-studies, concern was expressed regarding the manner in which equipment is acquired in the state. Modern equipment is essential to instructional and research computing, yet there is a perception that the current state procurement system for equipment requires from six months to a year for the simplest of acquisitions.

Faculty

Although the number of faculty appears adequate for most of the programs currently being offered, it must be recognized that this is a marginal situation. In almost every instance, if there should be a loss of two faculty members, the quality of the programs so affected would be in jeopardy.

The faculty teaching loads overall are very high. Table 9 compares FTE student to faculty ratios in several selected departments.

The training and background of the faculty are less than desirable. With some exceptions, the programs do not have a significant number of faculty members with formal training in computer science either at the master's or doctoral level. Overall, the faculty record of scholarly contributions to the field of computer science is weak. Under these circumstances, aggressive

TABLE 9--FTE Student-to-Faculty Ratios in Virginia Institutions, 1980-81

Level	Discipline			
	Computer Science	English	Physics	Sociology
Lower Division Undergraduate	35.29	19.18	19.88	25.74
Upper Division Undergraduate	18.05	14.01	6.00	13.16
Graduate	7.65	7.23	4.91	4.79

Source: 1980-81 DMM Reports.

programs in support of professional development and research are warranted, but in most of the institutions such programs have not been undertaken or are undertaken in a very limited way. Generally, the level of faculty credentials must be increased to ensure quality programs.

Almost all the self-studies indicated that new faculty for the programs are currently being recruited. In fact, many of the institutions had not been able to fill faculty positions in previous years. This phenomenon is a national problem, but it is made all the more acute in Virginia since many programs are functioning with a minimum number of faculty members. The shortage of faculty, coupled with increasing student enrollments, is leading to teaching and advising loads which are much higher than those encountered in other disciplines (Table 9). These circumstances make it increasingly difficult to retain the existing faculty, providing the potential to further complicate the problem.

Several institutions noted that an approach to partially solving the personnel problem is the retraining of existing faculty in other less heavily loaded departments. While this may result in some relief for lower division courses, it must be recognized that any such move requires considerable commitment by the individual to become a computer scientist and by the institution to support a significant amount of study. To teach other than certain specialized service courses, it should be expected that retrained faculty achieve a level of competence equivalent to a master's degree in computer science.

Salaries, for the most part, are below a competitive level when compared with similar institutions nationally and with industry. Although not yet widespread, the problem of inversion within the salary scale appears to be developing in several institutions. That is, the salary needed to recruit a new assistant professor may be greater than the salary of a currently employed higher ranking faculty member who has received only the standard raises given to the general faculty.

The computer science faculties tend to be heavily untenured and of junior status (Table 6). At many institutions nationally this has presented a problem when such faculty members are considered for promotion and tenure within the established procedures, normally controlled by the established disciplines. There is little in the self-studies to indicate that the situation will be different in Virginia, and the promotion and tenure issue may present a significant problem in the near future.

Students

The number of students applying for enrollment in computer science courses and seeking admission to computer science programs is increasing rapidly. This burgeoning growth is placing enormous pressures on already overloaded equipment and faculty resources. The institutions must make the hard decision whether to curtail enrollments or to supply the necessary resources to support expanding programs.

One mechanism for restricting enrollments is for programs to apply separate admission standards, but it is not clear that this would significantly inhibit the overall growth in student demands. In many cases, some of the growth experienced is from students returning to college after having received a degree in another field. Few institutions have addressed this need in any specialized program.

Administration of the Programs

Approximately half of the programs in the state reside in mathematics departments or combined departments that include mathematics. While this is understandable, given the historical development of the field, it must be recognized that as these programs become among the largest in the colleges and universities, the continued combination is probably unwise. It tends to downplay the importance of computer science as an independent field and can be confusing to students. At the very minimum it is necessary that the programs be administered by a person who clearly is identifiable as a computer scientist.

At least six titles are used for the degree programs in the state. While this is no doubt caused in part by political circumstances involved in program approvals, the practice is, at best, confusing to students and to employers. It also may cause some difficulties in recruiting faculty to the programs. All computer science degree programs in the state should be so titled in the future.

Library Resources

As a new discipline, computer science generally has not received adequate library support. Virtually every self-study expressed concern in this area. In a period when computer science has been expanding, library budgets have generally not been able to keep pace. As a result, it has been very difficult to build a usable collection of books in computer science and virtually impossible to obtain an adequate collection of journals and periodicals. While limitations in library resources have affected all disciplines, computer science did not have the opportunity to build collections earlier. As a result, significant corrective action is necessary to bring the library collections to even a minimally acceptable level.

Institutional Assessments

This section evaluates the individual computer science programs in the state. The assessments are based entirely on the self-studies submitted by the institutions, and as such represent a snapshot of the programs as of Fall 1982. Seven of the eleven institutions have initiated programs during or after 1980, and four of the programs were initiated in 1982. Therefore, some of the programs may offer promise even though they are not currently strong.

Christopher Newport College

The curriculum is sound, providing appropriate breadth in the core areas of computer science and a suitable selection of advanced electives. Supporting requirements in mathematics are acceptable. Access to a mainframe computer is available, and minicomputer services are provided on campus. There is a lack of micro-computer facilities for student use. Terminal access for students is poor; the available data indicate that the number of students per terminal is highest in the state. The number of terminals available for student use needs to be more than tripled to accommodate only the current computer science students in an acceptable manner. There is little provision for support personnel to assist computer users. Facilities for faculty computing are extremely limited. Library resources are unacceptable.

The faculty appears to have adequate credentials for a program at this level, but there is need for at least two additional faculty. While the backgrounds of the faculty are adequate, too few are regular contributors to the discipline. The teaching loads are quite high, and the salary scale low. Support for faculty development is low.

Admission to the computer science program requires no prior screening, and the general quality of students may be low.

Given the limited faculty, the dual offering of a computer science degree and an information science degree by one department is ill-advised. The institution should concentrate on only one of these programs.

George Mason University

The undergraduate curriculum includes a very heavy mathematics component. The computer science core is somewhat light and does not include operating systems at an advanced level. An appropriate number of advanced computer science electives are included. One year of engineering is required, but no additional science. The graduate curriculum, while basically sound, could benefit by expanding the requirements to include additional work in database and theory. The general-purpose centralized computing resources appear to be adequate at this time. The department needs its own micro-computers and access to a significant number of additional terminals. Better access is needed for faculty computing. Library resources are acceptable.

The number of faculty is far too small, considering that both undergraduate and graduate programs are being offered. The programs would have serious problems if two or more faculty members were to leave. The backgrounds of the faculty in computer science and their capability for research in the field are weak, as are their research records in computer science. The institution is supporting a program of professional development to enhance the backgrounds of the faculty, but it is not clear that this approach will generate the capability for research in computer science needed to support sound graduate programs.

The institution is considering how to limit computer science enrollments. As a result, the quality of the students may improve.

The program is growing and appears to have strong support from the university administration. A separation of the program from mathematics, among other things, probably would help in faculty recruiting.

James Madison University

The curriculum is somewhat light in computer science, requiring only a seven-course core and two advanced computer science electives. The area of operating systems appears to be missing from the core. With the exception of access to micro-computers, access to computing facilities is adequate, and additional micro-computers are being acquired. Access to equipment for faculty computing could be improved. Library resources are acceptable.

While some of the faculty appear to have excellent backgrounds in computer science, they are too few in number, and a significant portion of the instructional load falls to the mathematics faculty. The level of professional activity of the computer science faculty is generally low. Programs to support faculty development and research are also limited. Admission criteria for the program follow basically those of the university.

The program suffers potentially from being combined with mathematics and would benefit from a clearly defined coordinator of computer science.

Mary Washington College

The curriculum is light in required computer science courses. The core contains seven courses but lacks courses in the structure of programming languages. The requirement for advanced electives is such that all computer courses at that level, or all advanced mathematics courses, could be avoided. Only one year of science is required. Access to computing facilities is adequate except for access to micro-computers for laboratory courses. Better provisions should be made for faculty computing. Library resources are poor.

Faculty strength (four full-time) is at a minimum level to offer the program. The computer science background of the faculty is weak, and they are making virtually no scholarly contributions to the field. Teaching loads are high and salaries are somewhat low. There are inadequate provisions for support of faculty development and research. The arrangement with the Naval Surface Weapons Center at Dahlgren to provide full-time instructional help is commendable and to be encouraged. Care must be taken, however, to ensure the continuance of adequate instruction should that arrangement cease for any reason. The program does not have significant admission critera beyond those of the institution.

At this stage of the program's development it is probably best housed in its current administrative structure in physics and mathematics. There is a clearly defined coordinator for computer science.

Norfolk State University

The core curriculum is basically sound. The advanced electives were not specified in the institutional self-study and were thus impossible to assess. Only one year of science is required. With the exception of micro-computers for laboratory courses, the availability of computer hardware is adequate. Although the number of terminals for general use is currently inadequate, the self-study indicated that this is being corrected. Library facilities are weak, but the self-study indicated that collections are being improved.

The number of faculty available to offer the program is good, but their backgrounds in computer science are still weak. Some efforts are being made to upgrade faculty through development programs, and these efforts should be expanded. Teaching loads are high, and salary levels are low.

Based on self-study data about SAT Scores, the quality of the students appears to be quite low. Given the heavy demand for the program, it would benefit from establishing its own appropriate admission standards.

There is a clearly defined coordinator for computer science, but the program may still suffer from being combined with mathematics.

Old Dominion University

The undergraduate program contains a general core of seven courses. There are four upper-division options, each containing its own additional core requirement of from 3 to 6 courses. With the exception of the General Computer Science option, the areas of algorithms and language structure are not highlighted appropriately. The Systems Software and Computer Technology options appear to have weak mathematics requirements. The undergraduate program requires only one year of basic laboratory sciences.

The master's program, while basically sound, would benefit from additional requirements in the areas of operating systems and theory. While the doctoral program is new and therefore difficult to assess, it does not appear that sufficient research-oriented faculty are available to offer a strong program. Computing facilities generally are not acceptable, and the number of support personnel is inadequate. Library resources are inadequate, considering the requirements of graduate programs.

The faculty situation is mixed. There is an adequate number of faculty members, and, overall, they have adequate backgrounds in computer science. A few are regularly making scholarly contributions to the field. This low level of research activity is inadequate in a department which is offering a doctoral program. Additional funds need to be committed to faculty development and research.

The program admission standards for undergraduates are excellent. It appears that appropriate standards are being developed for graduate admissions.

The overall administration of the department appears to be very good. The only questionable area is the doctoral program which is jointly administered with mathematics. The arrangement seems cumbersome at best, and may lead to serious problems in the future.

Radford University

The curriculum, with the exception of the mathematics component, is very weak. There is too heavy an emphasis on elementary programming and introductory concepts; coverage of operating systems, computer architecture, and algorithms is inadequate. Numerical analysis is required at the core level, and while useful, it is a questionable core requirement. There is only one advanced level computer science elective. One year of science is required. Few support services are available, and the provisions for access for faculty computing are poor. Library resources are also poor.

Of the faculty teaching in the program, only three have primary academic credentials or extensive background in computer science. Two of these have major responsibilities in the computer center and teach a reduced load. A large portion of the teaching load is assumed by the mathematics staff. Overall, faculty expertise in computer science is judged to be weak. The university does not provide sufficient funds for faculty development. The program does not maintain its own admission standards.

Significant improvements must be made in faculty and resources if the program is to reach an acceptable level of quality.

University of Virginia

The undergraduate curriculum is basically sound. The core requirements are weak in the area of operating systems and computer architecture. The upper-level student can select as few as two computer science courses from advanced electives and statistics or discrete mathematics can be avoided. The graduate programs are strong. Computer access appears to be marginal and access to micro-computers is weak. The library resources are somewhat limited for the support of graduate programs.

The faculty is very good, with strong research records in computer science, and appear to compete favorably for external funds. The faculty is skewed heavily towards the assistant professor rank. This is surprising, as there have been computer science programs at the institution since 1965, and this may indicate a problem in obtaining promotions and tenure for the faculty.

Admission to the undergraduate program is through the School of Engineering, and the undergraduate students are of high quality. A possible criticism is the small size of the undergraduate program given its quality and resources. The program resides, combined with applied mathematics, in the School of Engineering, which dictates the limited enrollment. Some mechanism should exist for a joint program for students in the College of Arts and Sciences.

Virginia Commonwealth University

Both the undergraduate and graduate programs are listed as computer science tracks within degree programs in the mathematical sciences. As degree programs in computer science, they are weak. Six computer science courses are required in the undergraduate core and one additional advanced elective in computer science is required. The master's program fails to ensure adequate breadth in the areas of operating systems and computer architecture and theory. Equipment access is acceptable with the exception of access to micro-computers to support laboratory courses. There is limited support personnel available for the facilities. Library resources are weak, but measures are being taken to improve the collection.

The faculty is weak in computer science. There are three computer scientists; the rest of the instructional load is covered by mathematics faculty. The faculty make few contributions to the field of computer science, which is inappropriate for a graduate program. Salaries appear quite low, and there are unacceptable levels of support for development and research.

The post-baccalaureate certificate program, for individuals desiring additional work in computer science who are not ready for graduate programs, is an excellent concept.

Virginia Tech

The undergraduate curriculum, while basically sound, would be improved by a stronger emphasis on algorithms at the core level. The requirement for numerical methods in the core may give the program too heavy an emphasis on mathematics. The graduate programs are individually designed for the student. From the self-study materials, it appears that these programs are good. A dangerous aspect of the master's program is that the thesis/project requirement may be waived in lieu of similar experience gained elsewhere. The production of the doctoral program appears to be very low. Computing resources and equipment access are good. Support personnel for the equipment are limited. Library resources are good.

The faculty is good in numbers, background, and contributions to the field. Adequate support is available from the university and department for faculty development and research.

The admission standards for the undergraduate program are excellent and should help to ensure that quality students are in the program. Admission standards for the master's program require significant quantitative aptitude and achievement, but only limited experience in computer science.

The organization and administration of the department appears to be very good.

College of William and Mary

The undergraduate curriculum is fair. The core material covers all appropriate areas except operating systems and computer architecture. Details on advanced computer science electives were not given in the self-study.

Mathematics requirements are good except that statistics is not included as a requirement. Only one semester of science is required. The master's program appears weak with seven of the available courses being cross-listed core undergraduate courses. Access to central computing resources is good, but micro-computer availability is somewhat limited.

Excellent facilities are available for faculty research, primarily through joint programs with NASA. Library facilities, especially with the proximity of NASA, are good.

The size of the faculty is a problem, particularly considering the existence of the graduate program. Excluding the mathematicians and adjuncts listed in the self-study, there are apparently only two computer scientists in the program. The faculty contribution to the field of computer science is well below the level expected of faculty teaching in a graduate program, although there appears to be appropriate support for faculty development and research.

The quality of the undergraduate students is good. The self-study indicated that the quality of graduate students is somewhat weaker.

The placement of the undergraduate program with mathematics may have a inhibiting effect on the program. The placement of the graduate program in applied science is, at best, confusing.

To ensure the offering of quality programs in the future, it is essential that three or four research-oriented computer scientists be added as soon as possible, and an independent department should be created. Until these are done, the proposed doctoral program referred to in the self-study should not be undertaken.

Recommendations

Based on its review of the self-studies submitted by the institutions, the Task Force makes the following recommendations regarding the computer science programs in Virginia's state-supported institutions of higher education.

Facilities

The level of equipment support and access to computing resources must be improved significantly. Students majoring in computer science must be able to gain appropriate access to a variety of computing equipment. This equipment include the range of centrally available computer resources, and micro-computers. In addition, the students must have access to a variety of peripheral devices, software systems, and support personnel to assist them in the use of the facilities. Appropriate modern equipment must be available for faculty research and class preparation.

Where computing power is provided at a central facility, public terminals and computer ports should be available to undergraduate students (at least 20 hours a day, seven days a week) on a scale of at least one per 15 students enrolled in each course where significant computing homework is assigned. Sufficient computational power should be available to permit the use of modern full-screen editors with a response time of less than one second when all ports are in use. When the preferred vehicle for computing is stand-alone or networked micro-computers, a sufficient number of these devices should be available to provide at least one per 15 students enrolled in courses that require significant computing homework. The Task Force recommends that

- The institutions begin immediately to acquire sufficient computational support to provide terminal access on a scale of at least one per 15 students enrolled in courses that require significant computing homework. The magnitude of this upgrade in computational facilities should be achieved through specific state funding. In considering this recommendation, it must be remembered that computer science is not the only academic discipline making significant use of computers and therefore as the institutions and the State review the needs they must be certain to consider all student use.

There must be clearly identifiable sources of assistance to the students or faculty members using computers in the educational program. When the computing equipment is departmental, an appropriate number of technical support people must be assigned the responsibility for the equipment and access to it. Where the computing equipment is available through a central facility, there must be an individual responsible for academic user services, supplemented by appropriate full-time personnel and student assistants, to ensure that the equipment is available and questions from users may be answered in a timely manner. This is not simply another task that can be assigned to a computer center responsible for administrative work. The Task Force recommends that

- The Council of Higher Education determine the minimum personnel required for academic computer user services.

The procurement procedure for computing equipment presents a problem to all state colleges and universities. The academic programs cannot tolerate delays in acquisition of needed equipment and services. It is possible that delays are more often encountered at the institutional level than at the state level of the Department of Management Analysis and Systems Development (MASD). There is a perception by the institutions, however, that the primary bottleneck is in Richmond. The Task Force recommends that

- The Council of Higher Education, together with MASD, review the state procedures for acquiring computing equipment for instruction and research and prepare whatever revisions are possible to streamline the process. For example, such procedures should provide more institutional autonomy to acquire equipment such as terminals and micro-computers costing less than some reasonably established base price.

Faculty

The strength of the faculty, above all else, determines the strength of academic programs. Throughout the state there is a need to improve the levels of faculty credentials in computer science. As a result, all state institutions in their policies on hiring and promotion must stress the importance of improving faculty credentials as a primary consideration.

Most programs in the state are operating with a minimum number of faculty.

There are numerous opportunities for a faculty member to move to another institution or to leave academe. In order to maintain any level of excellence, the programs must remain competitive. The Task Force recommends that

- The Council of Higher Education review periodically the salaries in computer science to determine if they are competitive, and to take appropriate corrective action if they are not. The institutions are cautioned especially to be aware of the severe morale problems that may exist should inversions occur within the salary structure of a program.

Tenure and promotion policies remain a thorn in the side of many programs. The Task Force recommends that

- Each institution review its policies for their appropriateness to computer science as a relatively new and expanding discipline. Where clear problems are identified, remedial action must be taken.

Opportunities for professional growth and research are essential to all of the programs. The Task Force recommends that

- Each institution set aside special funds for professional development and research by the computer science faculty. At a minimum, enough money must be available to support the attendence of each faculty member at one professional national meeting per year.

The lack of faculty with the terminal degree in computer science has caused many institutions to hire faculty with other backgrounds. There are many examples of persons with master´s degrees in computer science now serving effectively in undergraduate programs. The Task Force finds this perfectly acceptable and therefore recommends that

- Those institutions without graduate programs make a careful study of the suitability of hiring individuals with a master´s degree in computer science.

Where this is found acceptable, the Task Force further recommends that

- The lack of the terminal degree not be a barrier to future promotion or tenure.

Several institutions indicated plans to retrain faculty from other disciplines to teach computer science. The Task Force recommends that

- Such retraining programs be developed in consultation with existing computer science faculty. At a minimum, such programs of study should include technical course material equivalent to the bachelor's degree in computer science and the necessary retraining should be done away from the home institution.

Students

The attractiveness of the computer science discipline has caused enrollments to grow, in some cases almost out of control. A danger exists that excellent students could be precluded from enrolling in courses they need. The Task Force recommends that

- Each institution, within the scope of its mission, develop program admission standards that ensure that the most qualified students can complete their programs in a timely manner. Such standards must be consistent with the likelihood of success in the study of computer science and reflect the limitations imposed by the availability of staff and resources.

Especially in the urban institutions, there is a significant demand for computer science programs by individuals already holding a bachelor's degree in another discipline. The Task Force recommends that

- The institutions consider offering a certificate program for these students, approximately equivalent to the required background for normal admission to a master's program.

Administration of the Programs

The Task Force believes that the best environment for computer science is an independent department. At the same time, it is recognized that that this may be precluded by practical or political considerations on a campus. At a minimum, there must be a clearly defined position of program coordinator who has responsibility for the resources and student programs. The Task Force recommends that

- Each institution evaluate carefully the administrative structure of its programs to determine the suitability of establishing an independent department of computer science if one does not currently exist.

The proliferation of program titles in the state is very unfortunate. It is confusing to students and to employers, and there is reason to believe that it inhibits effective recruiting of faculty. The Task Force recommends that

- The title of all computer science degree programs in the state be "computer science." Where, in fact, there is not a degree program in computer science, but rather a major in mathematics with a minor in computer science, the program should be called mathematics.

- The Council of Higher Education, in approving future programs in the computer science field, insist that the title "computer science" be used.

Library Resources

Library holdings in computer science in the state are weak in most institutions. At a minimum, the collections must include up-to-date monographs, journals, and the transactions and magazines of the ACM and the IEEE Computing Society, as well as representative publications of the major research organizations in the United States. The Task Force recommends that

- The Council of Higher Education encourage the institutions to reallocate funds to strengthen book and periodical collections in this area.

Individual Programs

There is a need throughout the state to upgrade the programs in computer science. Specific areas were identified above for each institution, and one computer science program requires immediate attention. Recognizing the demonstrated need for computer science programs of high quality in the Commonwealth, the Task Force recommends that

- The institutions and the Council of Higher Education investigate ways in which these problem areas can be corrected.

- Each institution re-evaluate its commitment to a quality program in computer science and general education and minors in computing for non-computer science majors. At a minimum, this commitment should be sufficient to meet the undergraduate requirements of the ACM IEEE/CS draft position paper.

- The Council of Higher Education, in evaluating new programs, use these same requirements in its decision making.

CHAPTER 3

MANAGEMENT INFORMATION SYSTEMS AND RELATED PROGRAMS

Introduction

The Management Information Systems Field

The development of the computer's capacity to store, manipulate, and produce quickly and efficently massive amounts of data has been a major impetus for the ever-expanding use of the computer in almost every aspect of society. Concurrently, the increasing complexity and interdependence of societal structures in the second half of the twentieth century has created an insatiable demand for reliable and timely information by all management levels. The computer thus becomes an important and effective tool to support the decision-making process, and the potential applications of computer technology to the planning and managing of organizations appear limitless.

The management information systems<1> field has developed within the computer science discipline in response to the need for persons who can identify, develop and apply the computer's technological capabilities to various functions within organizational settings. This field attempts to combine the computer science and business disciplines through academic programs that produce graduates having both technical competencies in use of the computers and broad understanding of the functions of management.

As the number of academic programs in the management information systems

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<1>Within the context of this discussion, the "Management Information Systems" field includes academic programs variously labelled as Management Information Systems, Information Science, Computer Information Systems, and Decision Sciences.

field has increased during the past two decades, various professional organizations have developed curriculum guidelines for the field. The Association for Computing Machinery (ACM) has issued curriculum guidelines for information science programs at both the baccalaureate and master's levels,<2> and the Data Processing Management Association (DPMA) has developed a model curriculum for undergraduate computer information systems education.<3> These curriculum guidelines attempt to define the minimal skills and competencies that are necessary in order to apply computer technology to management functions. The standards used by the American Assembly of Collegiate Schools of Business (AACSB) to accredit business administration programs are less specific in speaking to the place of computer applications in business education programs, stating only that undergraduate programs should teach "a basic understanding of the concepts and applications of accounting, quantitative methods, and management information systems including computer applications."<4>

A major issue in the development of the management information systems curriculum has been how best to structure the sequence and level of instruction in the computer science and business administration disciplines so that the student attains the desired competencies. At the baccalaureate level, a management information systems curriculum that gives equal emphasis to both the computer science and business administration disciplines will produce a graduate

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<2>ACM Recommended Curriculum for Computer Science and Information Processing Programs in Colleges and Universities. New York: ACM, 1981.
J. F. Nunamaker, Jr., J. D. Couger, and G. B. Davis (Eds.), "Information Systems Curriculum Recommendations for the 80s: Undergraduate and Graduate Programs," Communications of the ACM 25, 11 (November 1982), 781-805.

<3>DPMA Model Curriculum for Undergraduate Computer Information Systems Education. Park Ridge, Ill.: DPMA Education Foundation, 1981.

<4>AACSB Accreditation Standards and Interpretations for Business Administration Programs (Revised June 13, 1980). Standard IV(c).

who has fewer specific competencies in both disciplines than a graduate from a program in either discipline. At the graduate level, a switch in educational path from computer science to business or vice versa may require preparatory courses before entering the graduate program.

Although baccalaureate programs that combine elements of both disciplines continue with sustained enrollments and broad-based support, there appears to be a tendency developing to establish master's-level programs that are fed by baccalaureate programs in both management information systems and business. While an ACM national survey in 1979 identified 70 baccalaureate and 54 master's programs in the field,<5> a recent survey identifies about 100 graduate-level programs.<6> Two new master's programs illustrate this trend: the M. S. in MIS program at Boston University will focus on applying computer technology to business problems and will admit only students holding a baccalaureate degree in business, while the M. S. in MIS program at Rensselaer Polytechnic Institute provides business training to assist persons with technical training in moving into management positions.<7>

The lack of concensus in academe about the structure and place of the management information systems curriculum can affect the ability of the field to produce well-educated practitioners. There continues to be a strong demand for persons skilled in applying computer technology in the managerial environment, although specific employer needs vary by region. Employers are increasingly

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<5>J. F. Nunamaker (Ed.), "Educational Programs in Information Systems; A Report of the ACM Curriculum Committee on Information Systems," Communications of the ACM 24, 3 (March 1981), 124-133.

<6>MIS Research Center/McGraw Hill 1983 Directory of Management Information Systems and Faculty. Minneapolis: University of Minnesota, 1983.

<7>L. Paul, "RPI, BU Announce Master's in MIS Programs," Computerworld, March 14, 1983, p. 10.

voicing the expectation that new employees have broad-based mastery of technical skills and can be productive quickly. Such comprehensive technical skills, however, often can be gained at the undergraduate level only at the expense of the business courses which provide an understanding of management functions.

Management Information Systems Programs in Virginia

Eight degree programs in the management information systems field are offered by Virginia's state-supported institutions of higher education (Table 10). Six of the eight programs are housed in Schools of Business Administration; two are housed in Departments of Computer Science. Five of the programs were initiated during the 1970's and three since 1980.

The titles of the degrees range from "Information Systems" (four of the eight) to subsets of the generic "Business Administration." This variation in degree nomenclature may be attributed in part to the imprecise definition of the field itself. Nevertheless, it is also partly due to the reluctance of the institutions to more clearly label the programs for fear that the Council of Higher Education might deny approval to offer them.

During the 1981/82 academic year, Virginia's institutions of higher education awarded 223 degrees in the management information systems field, of which 216 were at the baccalaureate level (Table 11). The age of the baccalaureate programs does not appear to affect the number of degrees awarded. Although the newest program, at George Mason University, produced the fewest degrees (22), the oldest program, at Christopher Newport College, exceeded this number by only two. The most productive program was at Old Dominion University, graduating 87 persons, 40% of the total.

Seven master's degrees were awarded in the field during 1981/82. As with the baccalaureate programs, the age of the master's programs does not appear to have been a factor. Rather, the low productivity may be a reflection of

TABLE 10—MIS Programs in Virginia State-Supported Institutions, Fall 1982

Institution	Degree & Date Begun	Program	Department Housing Program
Chr. Newport	BS 1971	Information Science	Computer Science
George Mason	BS Fall 80	Business Administration (Major in Decision Sciences, Concentration in Information Systems)	Decision Sciences, School of Business Administration
	MS Fall 82	Information Systems	Decision Sciences, School of Business Administration
James Madison	BBA Fall 76	Management Information Systems	Management and Marketing, School of Business Adm.
Old Dominion	BS 1978	Management Information Systems	Management Information Systems/Decision Sciences, School of Business Adm.
Va. Commonwealth	BS 1974	Information Systems	Information Systems, School of Business
	MS 1972	Information Systems	Information Systems, School of Business
Virginia Tech	MIS Fall 80	Information Systems	Computer Science

employment demands and the general acceptance by employers of the baccalaureate degree as the entry-level credential.

During the 1982-83 academic year, 68 faculty holding full-time appointments and 22 holding adjunct or part-time appointments were teaching in the programs (Table 12). The majority of the full-time appointments were at the lower professorial ranks, and 27 (40%) of the full-time faculty were tenured. At three of the institutions, no faculty holding full professorships were associated with the programs. The salary averages by professorial rank for faculty teaching in the programs are shown in Table 13.

TABLE 11--Degrees Awarded in MIS Programs, 1981-82, Ranked by Date of Initiation

Institution	Program	Date Initiated	Degree Level	
			Bachelor's	Master's
Christopher Newport	Information Science	1971	24	
Virginia Commonwealth	Information Systems	1972		4
Virginia Commonwealth	Information Systems	1974	46	
James Madison	Mgt. Info. Systems	1976	37	
Old Dominion	Mgt. Info. Systems	1978	87	
George Mason	Business Adm.	1980	22	
Virginia Tech	Information Systems	1980		3
George Mason	Information Systems	1982		0
Total			216	7

TABLE 12--Faculty Teaching in MIS Programs, Fall 1982

Institution	Full-Time Appointments						Adjunct or Part-Time
	Professor	Assoc. Prof.	Asst. Prof.	Instructor	Total	Number Tenured	
Christopher Newport*	0	3	1	1	5	2	0
George Mason	0	4	3	1	8	4	4
James Madison	0	2	0	1	3	2	0
Old Dominion	2	5	7	3	17	6	3
Virginia Commonwealth	2	3	8	5	18	5	9
Virginia Tech*	3	8**	4**	2	17**	11	0
Total	7	25	23**	13	68**	30	16

*Faculty in Computer Science Department, teaching in several programs.
**Includes one off-campus Associate Professor and one off-campus Assistant Professor.

The Fall 1982 headcount number of major enrollments in the programs demonstrates a continuing student interest in the management information systems field (Table 14). The large number of part-time enrollments tends to indicate an interest in the field by persons already employed. Many of these persons are seeking the specific skills and competencies to enable them to move into the management information systems field, and this phenomenon --retraining for a new

TABLE 13--Salary Averages by Rank for Faculty Teaching in MIS Programs, 1981-1982

Institution	Faculty Rank			
	Professor	Associate Professor	Assistant Professor	Instructor
Christopher Newport*	NA	$24,625	$20,955	$18,000
George Mason	NA	32,975	26,000	NA
James Madison	NA	29,441	24,800	17,916
Old Dominion	$38,950	29,120	27,929	16,317
Virginia Commonwealth	40,250	35,778	29,500	20,940
Virginia Tech<1>	42,162	30,520	25,620	18,750

NA: Not applicable.
<1>Salary Averages are for all faculty in Computer Science Department.

TABLE 14--Headcount Number of Majors Enrolled in MIS Programs, Fall 1982

Institution	Undergraduate		Graduate	
	Full-Time	Part-Time	Full-Time	Part-Time
Christopher Newport<1>	223	202		
George Mason	25	7	1	32
James Madison	137			
Old Dominion	304	224		
Virginia Commonwealth	507<2>	447<3>		44
Virginia Tech<4>			3	5
Total	1,196	880	4	81

<1>Departmental enrollments; includes Computer Science majors.
<2>Includes 60 students in the post-baccalaureate certificate program.
<3>Includes 310 students in the post-baccalaureate certificate program.
<4>Enrollments for 1981-1982 academic year.

career-- probably will inflate part-time enrollments in the programs for the next several years.

General Assessment of the Programs

Several general issues concerning the management information systems programs emerge from the Institutional self-studies. These issues focus on the curriculum, faculty, students, and computer support.

Curriculum

The curricula of the management information systems programs vary across the institutions. Although the stated purpose of the programs generally is to develop competencies in computer technology for application to management functions, the course requirements in both the computer science and business disciplines vary widely. Both the ACM and the DPMA model curriculums for programs in management information systems identify suggested minimum competencies and core courses. The Task Force's assessment of each program's curriculum, taking into consideration these curricular models, is presented in the next section.

The departments housing the programs all have some process for assessment and modification of the curriculum. It is unclear, however, how these processes ensure that the content of the computer application courses maintain state-of-the-art content and reflect adequately the evolving technological applications in managerial settings. Moreover, linkages with employers of the programs' graduates appear haphazard, and the curricula consequently do not benefit from continuing external review by industry.

The programs do not present any clear education paths from the standpoint of articulation. There does not appear to be any significant student articulation between the baccalaureate programs and the business processing programs in the two-year colleges. Likewise, the master's programs require specific competencies in computer technology that severely limit entrance from other disciplines.

Faculty

The academic credentials of the full-time faculty teaching in the management information systems programs vary across a wide range of specific disciplines (Table 15). Approximately 40% of these faculty hold terminal degrees in computer science or mathematics, 30% in business fields, and 30% in physics, engineering, or other disciplines. Although many of them have received graduate instruction in management information systems, very few hold specific degrees in this field.

Recent employment experience in non-academic positions also varies greatly among the faculty, and although many do consulting work in the private sector, much of this is of a specialized nature tied to professional interests. Due to heavy teaching loads and the limited or non-existent financial support for faculty development in all the programs, it is difficult for the full-time faculty to maintain state-of-the-art competencies in the discipline.

Students

It is evident from the enrollment levels that student demand for the management information systems programs is strong. It is less clear, however, how the institutions ensure that students entering the programs have the capability to achieve competencies in both the business and computer science disciplines. Requirements for admission and retention in the programs become even more important in those programs that have substantial part-time enrollments because the monitoring of students' academic progress becomes more difficult.

The opportunities for student internships or directed work experiences in an employment setting vary greatly among the institutions. These opportunities, however, generally are informal and can accommodate only a small proportion of the total major enrollments. It is possible that a portion of the part-time

TABLE 15--Discipline of Highest Degree Held by Full-Time Faculty in MIS Programs

Discipline	CNC (N= 5)	GMU (N= 8)	JMU (N= 3)	ODU (N=17)	VCU (N=18)	VPI (N=17)	Total (N=68)
BUSINESS							
Business; Management		1	2	7	5		15
Business & Applied Economics		1					1
Economics					1		1
Public Administration		1					1
Management & Computer Science					1		1
Management & Systems Tech.				1			1
Total		3	2	8	7		20
COMPUTER SCIENCE & MATHEMATICS							
Computer Sci.; Applied Sci.	2	1				4	7
Computer & Info. Science						2	2
Info. Systems/Technology		1		1	2		4
Mathematics	2	1			2	2	7
Statistics				3		1	4
Statistics & Psychology					1		1
Quantitative Methods				2			2
Total	4	3		6	5	9	27
SCIENCES							
Physics					1	1	1
Engineering Management					2		2
Civil Engineering						1	1
Electrical Engineering						3	3
Industrial & Systems Eng.	1	1				1	3
Operations Research		1		2		1	4
Total	1	2		2	3	7	14
OTHER							
Agronomy						1	1
Clinical Psychology					1		1
Philosophy					2		1
Total					3	1	3
UNIDENTIFIED			1	1			2

students are employed in positions in the management information systems field, but this work experience is outside the structure of the academic curriculum.

The self-studies give little indication of monitoring by the institutions of the employment record of program graduates. Although a difficult and time-consuming task, the continuing collection and assessment of both graduates and employers' opinions of the programs' success in preparing well-educated practitioners is of great importance in academic planning. The lack of such activity makes it the more difficult to ensure that graduates of the programs have the competencies necessary to gain and retain employment in state-of-the-art settings.

Computer Support

A recurring theme in all the self-studies is the lack of adequate computer resources to support the management information systems programs. The most critical aspect of this problem is the lack of terminal access for both students and faculty. The amount and kinds of computer support vary greatly among the institutions (Table 16).

All the programs receive some support from the institutional computing centers. However, the programs of three institutions have no dedicated terminals or CPU's and must rely only upon limited access to the institutional computing facilities. Two of the programs receive support through dedicated equipment and terminals in the Schools of Business Administration that house the programs, and one program is supported by departmental CPU's and terminals.

The general lack of adequate computer support for the programs has a negative impact both upon the faculty and the students. Not only does this condition tend to limit the frequency and scope of "hands-on" assignments in the computer technology courses, thereby making intensive and comprehensive instruction more difficult, it also inhibits research and maintenance of state-of-the-art skills by the faculty. Students likewise are affected adversely by the lack of computer access, both in preparation for courses and in gaining experience in applying computer technology to management problems.

TABLE 16—Computing Equipment Available to Support the MIS Programs

Institution	Institutional (Shared Access)		Departmental/School	
	Mainframes/CPU´s	Terminals	Mainframes/CPU´s	Terminals
Chris. Newport	HP 3000-III IBM 370 at W&M via DATA100	20		
George Mason	Cyber 170/720 HP 2000	About 100		
James Madison	HP 3000-III (until replaced by VAX 11/780) IBM 3081/MVS at Va. Tech via batch RJE	44 (64)		
Old Dominion	DEC KL 1090 21 Superbrains	24	2 Vector Microsystems 2 TRS-I´s IBM PC	7
Va. Commonwealth	Amdahl 470 V7	30 (student) 24 (faculty)	HP 3000-III 1 Apple II 53 IBM PC´s 10 Compucolor II	28 (student) 2 (faculty)
Virginia Tech	IBM 3081 complex IBM 4341 Group 2 VAX 11/780		VAX 11/780 (linked to another VAX 11/780) HP 2100 6 LSI-11´s	52 (access both dept. and institutional CPU´s)

Institutional Assessments

Specific issues and concerns emerge from each institution´s self-study of its management information systems activities. It should be noted that several of the programs have been initiated within the past three years and the self-studies spoke to the program activities as of Fall 1982.

In assessing the curricula of the management information systems programs, the Task Force considered the curricular models proposed by the ACM and DPMA.

Although the general components of these suggested curricula are believed by the Task Force to be relevant to all programs in this field and many of the specific recommendations relating to specific curricula are based upon these models, the Task Force recognizes that variations in each institution's curriculum will arise due to diversity of institutional focus, mission, and response to local demands.

Christopher Newport College

The purpose and scope of the baccalaureate program are not clearly defined. Moreover, the title of the program, "Information Science," could be misconstrued as it is often used to identify an emerging field within the Library Science discipline.

The curriculum, possibly because it is housed in the Computer Science department, has a strong computer science orientation. The 58 credit-hour core curriculum includes a minimum of 15 hours in business and 18 hours in computer science together with courses in economics, mathematics, and psychology. Five other computer science courses are recommended electives; one of these, "Societal Impact of Computing" (CPSC 370), adds a useful perspective to the curriculum.

The computer and information technology components in the curriculum are very strong, and there are five required courses and four electives in this category. Course offerings in the area of systems development are adequate, but there are insufficient course offerings in the areas of information systems development and organizational systems.

The academic credentials of the faculty are primarily in computer science and mathematics (Table 15) and they appear to have little training or work experience in the management information systems field. With two notable exceptions, the faculty is not now actively engaged in research or publishing.

Enrollments in the program were relatively stable from its initiation in 1972 through 1977 and then tripled by 1982. In Fall 1982 about two-thirds of the program enrollments transferred to the new computer science program. If preference for the new computer science program continues, attrition in the Information Science enrollments may sap the program's vitality.

Computer support for the program appears minimal. The college-wide availability of only 20 interactive terminals is insufficent to serve the enrollments in the program. Moreover, student access to a large mainframe is limited to one batch link to an off-site location, and students have no opportunity to gain experience using the various micro- and personal-computers that are increasingly prevalant in employment settings.

George Mason University

The major in Decision Science within the baccalaureate program in Business Administration at George Mason University has a strong business emphasis. The core requirements include 33 semester hours in business and 18 hours in the Decision Science major, of which 9 hours are required and 9 are selected from one of three tracks. Although the institutional self-study mentioned the existence of an optional co-op program, no evidence was presented of the availablity of internships administered and monitored by the program.

Although there are strong business components to the curriculum, there is only one course in information system development and one in the area of organizational systems. The technical contents of the system programming track are very weak and the track does not include any courses in the development of information systems. Courses providing an essential background in systems development are also lacking in the decision support systems track, and the course offerings in the organizaticnal systems area likewise are inadequate.

The master's program in Information Systems is composed of 18 semester hours in required computer courses, nine elective hours (including a six-hour thesis option), and a three-hour capstone course. The prerequisites for admission to the master's program are equivalent to the Decision Support Systems track within the baccalaureate program. The master's program was initiated in Fall 1982, and only two courses have been offered.

The course offerings in the major area are inadequate. There are only three courses in the program that are oriented toward the management information systems major; the other courses are not normally associated with the field. Moreover, the program offers only one elective course in addition to the thesis option.

The academic credentials of the Decision Sciences faculty are fairly evenly divided between computer science and business (Table 15), and most of the faculty have work experience in management. Few of the faculty, however, appear to have special competencies or experience in the management information systems field. Many of the faculty are recent appointments and have not been actively engaged in research and publishing.

Although the baccalaureate program has only been in existence since Fall 1980, 22 students were graduated during the 1981-82 academic year. Basic competencies of entering students appear to be adequate, but no mechanisms for monitoring the employment records of graduates has yet been developed. Almost all students in the master's program are part-time enrollments, and the program is too new to permit any generalizations about enrollment patterns.

Computer support for both programs appears totally inadequate. Interactive access to the recently installed institutional computer is severely limited. The institution is aware of this critical problem and is attempting to acquire additional peripheral equipment but the self-study recognizes that inevitable delays in installation adversely affect the program. Students in both programs also lack access to micro- and personal-computers.

James Madison University

The baccalaureate management information systems program at James Madison University appears effectively to combine the business and computer science disciplines. The program includes a 42 semester-hour core in business and a 27 semester-hour major concentration, of which 21 hours are computer science. Several courses in the latter group, such as "Forecasting Methods for Management" (MGT 475) and "Decision Making: Theory and Practice" (MGT 483) clearly focus on computer applications to management functions. A supervised internship in data processing is available to students in the program.

The course offerings in computer and information technology are strong and the technical courses are well selected. The program, however, includes insufficient courses to provide a strong background in systems development and the development of information systems. Great latitude is given the students in course selection, and, as a result, the students may take a sequence of courses that offer inadequate preparation for a career in the field. There are essential courses in each elective group which may be avoided by the student. For example, a student may elect courses in RPG II, FORTRAN, Systems Operations, Operations Research, and Decision Making, and this combination of electives would result in a rather weak curriculum.

The institutional self-study identified only three faculty as teaching in the program, two of whom have academic credentials in business (Table 15). (No credentials were identified for the third faculty member.) Even assuming that many of the computer courses are taught by other faculty, the 137 headcount major enrollments in the program suggest a very heavy faculty workload.

Competency requirements for entrance into the program appear adequate and the academic progress of the students is monitored. The institution has made efforts to ascertain the employment history of graduates from the program and the self-study reports that approximately 60 percent of the graduates are employed (although the specific employment settings are not specified).

Computer support for the program appears minimal. Although the institution is upgrading its institutional computer with an installation that will support an additional 20 interactive terminals, support for academic computing will remain limited. Students in the program do have limited batch access to the IBM 3081/MVS at Virginia Tech, but "hands-on" experience with either mainframe configurations or micro- or personal-computers is marginal at best.

Old Dominion University

The management information systems program at Old Dominion has a strong business focus. The program requirements consist of a 92 semester-hour business core, of which 18 hours are introductory instruction in Management Information Systems and Decision Sciences, and a 30 semester-hour concentration, of which 18 hours are advanced computer technology coursework. Several of the concentration courses, such as "Computer-Based Decision Models for Management" (MISDS 410) and "Inventory Systems and Materials Management" (MISDS 432), focus on computer applications in business.

A cooperative education program with local business and industry provides opportunities for directed internships for a limited number of students. In Fall 1982, 17 students (approximately 8 percent of the full-time majors) were participating in the program.

Course offerings in the areas of organizational systems and the development of information systems are very good, and the cooperative education program provides students with exposure to the job environment. The curriculum, however, lacks background courses in the area of systems development, and technical offerings are restricted to one required, and limited elective, courses.

The academic credentials of the faculty are evenly distributed between business and computer science (Table 15). Only one of the faculty, however, has a terminal degree in the management information systems field, and the faculty generally have limited recent work experience in managerial settings.

Students entering the program appear generally to have adequate basic preparation, due in part to the six-course lower-division core requirement, but the self-study did not address how students acquire the necessary computer compentencies to enter the upper-level computer applications courses.

The institution has made an attempt to monitor the employment status of the program graduates, and the self-study reported that 96 percent of those responding to a survey were employed (although specific employment settings were not specified.)

Computer support for the program appears adequate. Students have access to the institutional mainframe through 24 shared access terminals and seven interactive terminals in a dedicated facility in the School of Business Administration. All students receive some "hands-on" experience with micro- and personal-computers.

Virginia Commonwealth University

The baccalaureate program in information systems includes a 36 semester-hour core of business courses and 27 semester-hours of information systems, of which 21 hours are in specifically required courses and six are required information systems electives. While the core requirements are clearly defined and include state-of-the-art content, the focus of the program appears to be data processing systems rather than management information systems. An internship program was initiated in Fall 1982.

The baccalaureate curriculum adequately covers three of the four areas in the ACM curriculum model. The basic program requirements, and the course offerings in the area of development of information systems, are strong. Only one course is offered in the organizational systems area, however.

A post-baccalaureate certificate in Information Systems is offered for persons who hold a bachelor's degree in another discipline and who do not aspire to a master's degree. This certificate program consists of a minimum of 24 semester-hours of required, and 6 semester-hours of elective courses at the undergraduate level.

The master's program in information systems requires a minimum of 30 semester-hours of graduate coursework; a thesis also may be required. An additional 24 semester-hours in foundation business courses are required for those students lacking such courses at the bacclaureate level. The master's curriculum offers a set of advanced courses that provide state-of-the-art content with a clear focus on management information systems. Such courses as "Computer Performance Evaluation" (BUS 666) and "Telecommunications" (BUS 667) are designed to enhance the skills of the practitioner.

The master's program contains strong course offerings in the area of organizational systems and the selection of technical courses required for the degree is excellent. The program, however, does not offer any elective courses in the management information systems area.

The academic credentials of the faculty teaching in the Information Systems programs are fairly evenly split between business and computer science and related scientific disciplines (Table 15). Three of the full-time faculty, however, hold their highest degrees in Philosophy or Clinical Psychology. The programs also rely heavily on adjunct faculty and have experienced a very high turnover rate in the full-time positions during the past seven years (especially at the Assistant Professor rank, which experienced a turnover during that period of 8 faculty, or 114.3%).

Student enrollments in the two programs are the highest among comparable programs and continuing interest in the field remains high. Both programs appear to attract students with adequate basic competencies. The institution has not developed a continuing mechanism for monitoring the employment paths of the baccalaureate graduates. Students in the master's program come from a variety of employment settings.

Computer support for the programs is provided through access to the institutional mainframe and a dedicated facility housed in the School of Business. Access to both is limited, however, with only 30 student and 24 faculty interactive terminals tied to the institutional facility and 28 student and 2 faculty terminals tied to the Business computer. The program also has 64 stand-alone micro-computers available for student use. Nevertheless, given the large enrollments in both programs, terminal availability is severely limited.

Virginia Tech

The master's program in Information Systems at Virginia Tech, perhaps because it is housed in the Computer Science Department, has a strong computer science focus. The program requires a minimum of 45 quarter-hours of course work and the curriculum components are drawn from the total graduate offerings of the department and specific courses offered by the College of Business. The course offerings in management information systems and related areas are strong.

No specific curriculum is specified for students to follow in the program; a specific set of courses is selected by each student in consultation with faculty advisors. There are no business requirements associated with the program, either as undergraduate prerequisites or as elective or cognate courses. Indeed, the general curriculum of the program does not appear to differ from that of the master's program in computer science.

Almost all the full-time faculty in the Computer Science Department hold terminal degrees in either computer science or engineering. Conversely, none hold terminal degrees in business or related fields. The faculty have limited recent work experience in management settings, although many devote a substantial effort to consulting in the business community. As would be expected in a major research university, the faculty are involved heavily in research and publishing activities.

Requirements for admission to the program are the same as for the master's program in computer science and require a strong technical preparation. The program's enrollment is rather small, and it has produced annually relatively few graduates, perhaps because of its recent initiation. The institution has monitored the career path of graduates.

Computer support for the program is adequate. Besides the adequate institutional computing facilities, the computer science department maintains a variety of dedicated machines and peripheral equipment. Students have available 52 interactive terminals that access both the departmental and institutional facilities.

Recommendations

Based on its review of the management information programs offered by Virginia's institutions of higher education, the Task Force offers several recommendations of ways to strengthen the programs. Many of the recommendations are applicable to all the programs; these are presented first. These general recommendations are followed by specific recommendations concerning the individual programs.

General Recommendations

There are eight programs in the management information systems field offered by Virginia's state-supported institutions of higher education. Six of these are housed within Schools of Business Administration: three are named "Information Systems," two "Management Information Systems," and one "Business

Administration." All six emphasize management applications, both in program title and in curricular focus. The other two programs are housed in departments of computer science. Although the Christopher Newport program is named "Information Science," it is intended to focus on management information systems applications. Although named "Information Systems," the Virginia Tech program is not focused on management information applications in a conventional sense. The Task Force recommends that

- The titles of the academic programs clearly delineate their purpose: if the curriculum is intended to produce graduates who will work in settings requiring computer applications in the management environment, then the program title should contain the word "Management."

The ACM and DPMA models for management information systems programs identify suggested minimum competencies and core courses for the programs. Although strict adherence to these models is neither necessary or desirable in all instances, given the diverse missions of the institutions, the basic competencies identified by the models should be incorporated into the programs. The Task Force recommends that

- The institutions, in developing and maintaining the curriculum of their management information systems programs, incorporate the recommendations of the ACM and DPMA insofar as possible.

The industry representatives with whom the Task Force met also suggested specific competencies and concepts that ought to be included in all management information systems programs. The programs ought to include logical processes and approaches to large systems analysis and design. Fundamental concepts such as life cycle analysis, cost benefit analysis, and end-user orientation ought to be fundamental components of the programs.

The continuing assessment of the curriculum's effectiveness in producing well-prepared practitioners is of vital importance to the long-term vitality of the programs. Review of the career paths of graduates and assessment of employers' evaluation of the programs assists greatly in curriculum planning and revision. The Task Force recommends that

- The institutions track the employment performance of the program graduates and maintain frequent contact with their employers.

Few of the faculty now teaching in the management information science programs hold terminal degrees or formal training in the field. Given the heavy enrollments in the programs, additional faculty will be needed to support the programs in the future. The Task Force recommends that

- The institutions, whenever possible, hire as new faculty only those persons who hold terminal degrees or have extensive formal training in the field.
- The institutions expand their faculty development programs to support additional education for currently-employed faculty who may lack specific competencies or expertise in the management information field.

Recent private-sector employment experience of the management informations systems faculty varies greatly. Some faculty serve as consultants to business and industry, and others periodically seek short-term employment in various management information settings. Such linkages between the academic faculty and the private sector both enhance awareness by academe of current technological practices and applications and provide opportunities for the cultivation of support by the private sector for the academic programs. The Task Force recommends that

- The institutions encourage periodic work experiences by faculty in private sector job settings and recognize the benefits of this experience to the management information systems programs.

As enrollment levels continue to grow faster than program resources, it is important that the institutions develop screening mechanisms for the selection of applicants for the programs. The identification and selection of the most qualified applicants will help to ensure the quality of the programs and will assist the institutions in allocating effectively the available enrollment slots. The Task Force recommends that

- The institutions develop and apply specific criteria for the screening and selection of applicants to the management information systems programs.

Although there is a practical limit to the number of students who can be placed and supervised in external job settings during their academic program, these activities provide an important supplement to the academic curriculum and afford both an opportunity to strengthen specific skills and an awareness of the job environment. The Task Force recommends that

- The institutions support student participation in internships or directed work experiences to the maximum extent possible.

Maintaining adequate computer support for the management information systems programs is a continuing challenge for the institutions. Adequate terminal access for students and faculty, adequate machine-time for faculty, and availability of computer resources (including micro-computers), appropriate software, and support personnel are all absolute necessities in supporting the programs. Each of these components of the adequate computer support environment is important, and they are all interrelated. The Task Force recommends that

- The institutions design and implement a continuing process to assess and plan for the academic computing environment.

- The institutions provide at least one terminal for every fifteen student enrollments in all courses that include assignments using computer facilities. Additional terminals should be available to faculty teaching such courses.

One of the most difficult aspects of maintaining adequate computing support for the programs is securing costly machinery. Although non-General Fund support cannot, and should not, substitute for adequate appropriations to sustain the programs of the state-supported institutions, it can supplement the basic state funding and greatly enhance the programs' vitality. The Task Force recommends that

- The institutions actively seek non-General Fund support for the acquisition of equipment, either through donation or grants.

Specific Program Recommendations

The Task Force offers specific recommendations to strengthen the curriculum of each of the management information systems programs currently offered. These recommendations were developed within the context of the ACM and DPMA model curricula, and, in the judgment of the Task Force, would more clearly define the focus of the management information systems curriculum.

Christopher Newport College

* Replace FORTRAN with an information systems-oriented course. FORTRAN is seldom used in management information science applications.

* Replace the Operations Research course with an information systems course or a computer technical course that is directly applicable to the field. Operations research is not often required in a management information systems program.

* Offer a course in database management systems.

* Strengthen the area of information systems development.

George Mason University (baccalaureate program)

* Offer at least one more course in the area of organizational systems.

* Offer a course in data structure analysis or file organizations.

* Offer at least two courses in the area of development of information systems.

* Offer more courses in the computer and information technology area. Each track should have sufficient technical offerings in its specialty. The Computer Systems Programming track should have some courses in operating systems, systems programming, and data communications, for example.

* Replace FORTRAN with a course more oriented to information systems.

George Mason University (master's program)

* Add at least three courses in computer and information technology and in the development of information systems. Courses such as EDP Auditing, Systems Simulation, and Systems Development Projects would enhance the curriculum.

* Increase the number of elective courses in the program.

James Madison University

* Increase the number of required courses to cover COBOL, Advanced COBOL, DBMS and Systems Analysis, in addition to the two courses in the organizational systems group.

* Add at least one background course such as Data Structure or File Organizations.

* Add at least one additional course in the area of development of information systems.

Old Dominion University

* Add more courses in Data Structure Analysis and in DBMS.

* Increase the number of required courses in the area of computer and information technology.

* Replace RPG II with a course in information technology.

Virginia Commonwealth University (baccalaureate program)

* Add at least one course in the area of organizational systems.

Virginia Commonwealth University (master's program)

* Add specific elective courses that focus on information technology and the development of information systems.

Virginia Tech (master's program)

* Develop a set of specific course requirements for the curriculum.

* Include in a required core curriculum such key courses as Advanced Information Systems Design, Advanced Information Systems Analysis, and Data Processing Management.

CHAPTER 4

DATA PROCESSING ASSOCIATE DEGREE PROGRAMS

Introduction

Twelve of the twenty-three institutions within the Virginia Community College System (VCCS) offer Associate in Applied Science (AAS) degree programs in Data Processing (Table 17). This report concentrates only on academic computing at those twelve institutions even though other colleges were scheduled to begin offering the AAS in Data Processing degree in the near future. Nevertheless, this report will have significant meaning for all the VCCS member institutions as it evaluates such universal topics as curriculum, the computing network, fiscal support, faculty qualifications, articulation, admissions, and

TABLE 17—AAS Degrees in Data Processing in Virginia's Community Colleges, Fall 1982

Institution	Date Initiated	Division or Department Housing Program
Blue Ridge	1979	Business and Secretarial
Central Virginia	1968	Engineering Technology
Danville	1968	Business and Data Processing Services
J. S. Reynolds	1973	Business and Public Service Technology
John Tyler	1967	Business
Northern Virginia	1967	Varies by Campus: - Business - Business - Natural and Applied Sciences - Communications and Human Studies - Business and Social Sciences
Piedmont Virginia	1979	Business Technologies
Southwest Virginia	1982	Business
Thomas Nelson	1968	Business Science
Tidewater	1969	Business
Virginia Western	1970	Business Science
Wytheville	1978	Business, Engineering Technologies and Mathematics

business and industrial relations, most of which are largely prescribed at the System level. In fact, while institution-level data are used throughout, most of the recommendations found in this chapter are focused upon the System office. Given the present system configuration, the Task Force believes that the greatest potential for change resides in the central office.

This decision to concentrate on global or generic phenomena rather than the strengths and weaknesses of the individual programs was made during the investigation, not *a priori*. Repeatedly, the colleges responded to Task Force requests for data either by quoting VCCS policy (*i. e.* faculty qualifications, "open-door" philosophy, curriculum standards) or by stating that important matters were controlled at the System level (*e. g.* computing network and overall budget allocations). The Task Force devoted considerable time and effort attempting to ascertain the accuracy of these themes. It concluded that, while the precise nature of the balance between institutional autonomy and system-level control could not be known, there is an all-but-universal perception at the institutional level that the colleges are not in a position to make substantive or sweeping changes.

Students

The Community College Admissions Philosophy

Community colleges in Virginia share a common philosophy, a philosophy which is firmly grounded upon the concept of the "open door." This concept allows any person who has a high school diploma or the equivalent, or who is 18 years of age and is able to benefit from a program of study at a given institution, to be admitted either as a regular student, a special student, or a non-curricular student. The determination of status --regular, special, or non-curricular-- depends upon the desires and academic background of each student. While other sections of this chapter deal with the data processing program in depth, this portion points out the effects of the interpretation and application of the "open door" on that program.

All institutions reported a recent upsurge in data processing enrollment and a resulting strain on equipment, facilities and faculty. The expanding enrollments may be due as much to widespread interest in computing and the desire to obtain some measure of computer literacy as they are to economic pressures to obtain marketable skills. Those students who seek a career in data processing may face serious disappointment, since Virginia was producing sufficient two-year program graduates to meet expected employment demands well before the recent surge in program enrollments (Table 1).

The way the VCCS implements the "open door" philosophy has resulted in classes and laboratories at many institutions being filled to overflowing with students whose academic preparation is grossly heterogeneous. Data processing students may be assumed to have the required mathematics background, but those who enter through the special or noncurricular routes may not. Some of the latter groups may, by policy, be concurrently enrolled in developmental arithmetic. The potentially devastating effects on instruction are self-evident.

The implementation of open door has prompted the absence of established data processing program enrollment ceilings at eleven of the twelve colleges. Some institutions reported de facto ceilings accomplished through limiting the numbers of sections or work stations, while others stated that they were considering the advisability of establishing real ceilings.

During a meeting of a Task Force subgroup with the VCCS Chancellor, it was indicated that the three primary objectives of the VCCS mission are (1) Occupational Skills development, (2) transference of credits to other institutions, and (3) continuing education, in that order of priority, but that individual institutions were free to modify this ordering based on local needs.

Overloading versus Enrollment Limits

Faculty-student ratios for the community colleges' data processing programs are much smaller than those for the senior institutions' programs in the computer science discipline. Compared to other disciplines offered by the community colleges, however, the data processing faculty-student ratios are very high. Class sizes of 24 to 27 students (Table 18) are regarded with dismay by faculty who have four or more classes to teach and perhaps several different preparations. Moreover, data processing is a laboratory subject, and instructional quality is affected not only by the faculty-student ratios but also by the accessibility to equipment by students and faculty. The data suggest that without huge funding increases for additional resource support, the institutions must decide, and decide quickly, between program quality and their propensity for permitting nearly anyone to take nearly all data processing courses.

TABLE 18—Student Class Size in Data Processing Courses

Institution	Number of Class Sections	Headcount Enrollments	Average Enrollments Per Class Section
Blue Ridge	NS	374	NS
Central Virginia	45	1,026	22.8
Danville	7	180	25.7
J. S. Reynolds	53	1,530	28.9
John Tyler	21	492	23.4
Northern Virginia	215	5,725	26.6
Piedmont Virginia	NS	NS	22.0
Southwest Virginia	8	224	30.5
Thomas Nelson	32	878	27.4
Tidewater	68	1,813	26.7
Virginia Western	31	930	30.0
Wytheville	8	188	23.5
Total	488	13,360	26.6<1>

NS: Data not submitted in institutional self-study or supplementary response.
<1>Adjusted by deletion of institutions that did not submit data.

Attrition Rate

The self-studies reported attrition rates for data processing which at first glance are somewhat startling (Table 19). Whereas beginning courses are over-subscribed, the number of enrollees in second-year classes is small and the number of graduates even smaller.

TABLE 19--Total Enrollments and Graduates of Data Processing Programs, 1982

Institution	Year Program Initiated	Fall 1982 Headcount Enrollments	Fall 1982 Majors	1982 Graduates
Blue Ridge	1979	374	128	11
Central Virginia	1979	1,026	302	19
Danville	1968	180	132	21
J. S. Reynolds	1973	1,530	778	26
John Tyler	1967	492	413	24
Northern Virginia	1967	2,725	916	98
Piedmont Virginia	1979	NS	162	17
Southwest Virginia	1982	224	155	0
Thomas Nelson	1968	878	497	25
Tidewater	1969	1,813	1,050	41
Virginia Western	1970	930	520	<1> 16
Wytheville	1978	188	117	19
Total		13,360	5,170	323

<1>Average over more than one year.

At least four explanations for the high attrition rates are possible. First, many students never intend to complete an entire data processing degree program, but instead declare data processing as their "major" although it is merely an area of interest or curiosity. Second, students often enroll in data processing courses as a means of supplementing their other studies and reinforcing their employability in that field. Third, students may secure employment or promotion after completing selected data processing courses and leave before completing the program. Fourth, students lose interest or perform poorly due to inadequate advising upon admission. In any event, faculty, facilities, and equipment are being stretched beyond their normal limits to serve non-data processing students who might well be better served in other ways. A level of computer literacy may suffice for these students, and this can be provided outside the data processing program.

High School and Entry-Level Counseling

Adequate counseling of prospective data processing students is essential both at feeder high schools and on entrance to the college. High school counseling is needed not only to assist the community colleges in restricting their already overloaded classes to earnest students but also to avoid wasting a student's time in enrolling in the wrong major. So long as data processing (or Computer Science in four-year institutions) is a glamour area, especially in times of reduced employment opportunities, there could be a tendency for students to be funnelled into the field without adequate preparation or screening. Scientific, technical and professional organizations, such as the American Federation of Information Processing Societies, provide brochures and guidance in this area.

Articulation

The Associate of Applied Science (AAS) degree is, by definition, a terminal degree, and the curriculum of the data processing program is designed primarily to prepare students for immediate employment upon graduation. Although specific data processing courses may be transferred to baccalaureate programs in the computer science discipline on an individual basis, the programs themselves do not substitute for the first two years of a baccalaureate program. The community colleges generally counsel entering students that the data processing program does not articulate, although senior institutions continue to receive inquiries from two-year graduates who wish to transfer with junior-level status.

The senior institutions face a major, and complex, problem in articulation, however, in responding to the needs of students who return to higher education after gaining employment. Many employers support continued education by their employees through tuition assistance and adjusted work schedules which temporarily add to employer costs and reduce staff productivity, and they encourage these working students to complete their courses of study in a timely manner. To the extent that prior education and competencies obtained through data processing courses and strengthened through job experience, cannot be transferred or converted to credits applicable to the baccalaureate degree, both the working student and the employer become increasingly frustrated and disillusioned with both the community colleges and the senior institutions.

Entrance Requirements and Course Prerequisites

The presence of ill-prepared students in a class places the instructor in a difficult position. A natural reaction may be to lower standards and thus to compromise the overall level of presentation not only in that class but also in all other classes for which it a prerequisite. The opposite reaction is also catastrophic, because the instructor who teaches only to the fully-prepared student may end up with no one to teach.

On entrance to the community college, students who do not possess the prerequisites must enroll in remedial courses before they can be called data processing majors. However, in several colleges for which documentation was available, a student may enroll concurrently in remedial and data processing courses. This incongruous set of standards compromises the instructional enterprise and all but negates the function of any program entrance requirements. Moreover, since the self-studies showed that faculty feel that class sizes are too large, this practice actually aggravates a problem which it was designed to remedy partially.

Minimal Achievement Standards for Continuation

While passing grades in a course are determined by some minimal set of standards, the grade level which is necessary to proceed to a subsequent course may be much higher. Such standards should be considered seriously in constructing a sequence of courses for students majoring in data processing. Students who graduate in the mid-1980's will still be active in the field in the twenty-first century and through several successive generations of computers, each more complex than the previous. It is essential that the graduates be able to continue their learning for several decades after graduation.

Recommendations

The selection, retention, and articulation of qualified students is of great importance to the maintenance of quality in the data processing programs. The Task Force recommends that

- The institutions develop data processing program admissions standards for the screening and selection of applicants to the programs. While some institutions have restricted enrollments to the _first_ students who apply for admission, it would be more appropriate to select those to be admitted from a wider group and to choose those who intend to pursue a career in data processing and who have the necessary preparation. This implies that students who desire only to obtain a measure of literacy in the field will have to be served in other ways, ways which do not interfere with those who have a data processing career orientation.

- The institutions base class sizes and numbers of sections on the availability of sufficient student access to the academic computer systems and instructional staff.

- The institutions work closely with their area high school counselors, passing on the expectations for entry into the data processing program to them and seeking ways to avoid undue subject matter duplication.

- The Council of Higher Education, the senior institutions, and the VCCS investigate ways by which students enrolling in baccalaureate programs in the computer science discipline may receive appropriate academic recognition for data processing courses and relevant competencies.

- Data processing faculty consider raising the minimum grade necessary to continue into the next data processing course to "C."

- The institutions apply the "open door" as it was intended, namely as a way of conveying the thought that (nearly) all persons may enter the college. In going beyond that, to the point of allowing nearly anyone to take data processing courses whether or not they possess the prerequisite knowledge and aptitude, the colleges have exacerbated the problems with faculty, budget, and computing support that they are lamenting.

Curriculum

Overall, the twelve curricula are strikingly similar (Appendix III). By housing their data processing curricula within business-type divisions (Table 17), many of the colleges have clearly aligned the instruction with the field of management information systems rather than that of computer science. Two colleges did report new or proposed "computer science" options within their science curricula. Since these were actually science programs with a smattering of courses dealing with computer applications, they were given only passing attention in this study.

The data processing curricula generally reflect a commitment to comprehensiveness and to the prime object of the programs --that of preparing graduates for immediate employment by providing occupational skills in a number of commonly-used languages. The number of credit hours in the data processing core curriculum at the twelve colleges ranges from 46 to 52 (Table 20). This is due partly to the variation in number of languages and language courses contained in the core curricula.

Many of the differences between curricula can be attributed to institutional responses to local needs. This desire to serve local needs is consistent with the community college philosophy, and is a noteworthy strength of the system as a whole. Curricular differences which cannot readily be attributed to local preference were also found. The Task Force recommends institutional and system-wide study of these and of the occasional significant omissions (noted below) in the data processing curricula.

TABLE 20--Programming Language, Core, and Degree Credit Hour Requirements of Data Processing Programs, Fall 1982

Institution	Programming Languages			Core Credit Hours	Degree Credit Hours
	Number	Courses	Credit Hours		
Blue Ridge	3	5	17	36	97
Central Virginia	5	9	34	52	97
Danville	4	6	24	39-43	94-98
J. S. Reynolds	3	5	19	40-44	98-102
John Tyler	1	2	8	43	98
Northern Virginia	2	3	12	39	97
Piedmont Virginia	2	4	14	41-44	96-99
Southwest Virginia	4	6	22	44	104
Thomas Nelson	2	4	15	44	100
Tidewater	2	5	16	40-46	97-103
Virginia Western	4	6	23	48	97
Wytheville	5	7	24	45	99

Invariably mentioned by employer groups as a shortcoming of all levels of management information system and data processing education is student training in "real world" computing situations. Citing student lack of appreciation for such mundane topics as cost/benefit analysis, the role of the user, project management, life-cycle methodology, documentation, manufacturing process control, system management, and the like, they urge much greater attention to the world of work.

In setting forth its curriculum recommendations, the Task Force finds itself in agreement with the Association for Computing Machinery's (ACM) Committee on Curriculum for Community and Junior College Education.<1> In 1981, following a five-year study, that group divided the data processing curriculum into three categories: required or core computer content, optional computer

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<1>J. V. Sweeney, J. C. Little, I. H. Lee, R. A. Walton, and R. W. Woodcock, Recommendations and Guidelines for an Associate Level Degree Program in Computer Programming. New York: Association for Computing Machinery, 1981.

content, and related content. The ACM stressed the need for community colleges to address local needs while assuring that content contained "indepth programming knowledge, techniques and skills supported by training in problem solving and logical analysis . . . fundamental concepts of hardware and software and organizational, social, psychological and economic matters which make up the environment of the programmer. . . ." As for languages, the ACM stated "the major languages should be selected on the basis of need in local industry and be supported by more limited experience with at least one other computer language . . . and a foundation in assembler concepts in order to provide a better understanding of hardware/software interaction and compiler-generated code." Throughout its report, the ACM urged "practical projects" and indepth appreciation of the tools and the constraints of the analyst's profession. Thus, extensive use of traditional documentation forms is essential. The ACM also emphasized English, communications, business knowledge, mathematical knowledge and general education. Recognizing that 70% of a programmer's work is writing and problem solving, the Task Force concurs.

Elsewhere in this chapter the Task Force addresses articulation with and student transfer to upper-division institutions. It is through curriculum that the degree to which this will happen is largely determined. Careful curricular design coupled with accurate advising and the judicious selection of electives allow the student to earn the occupational/technical AAS degree while making progress towards the bachelor's degree.

Lastly, curriculum must not be static. This may well be the most important observation of all. Great changes are occurring in the marketplace and community colleges pride themselves in their responsiveness to such changes. Employer after employer told the Task Force that they are looking for employees who can think, solve problems, and be analytical. Some added that, given the current glut of unemployed, educated individuals, they are hiring baccalaureate Arts and Science graduates to fill traditional entry-level data processing vacancies rather than the two-year AAS Data Processing graduates. They are doing so based on a belief that the data processing skills can be easily learned but logical thinking and good communications skills are much harder to acquire. The baccalaureate graduate is presumed to have these in substantially greater quantity and quality than does the AAS graduate.

Findings

The twelve institutions are generally responsive to the expressed needs of their local areas and their curricula reflect this.

Several institutions appear to be more cognizant of the issue of transferability than are their sister institutions. While all the institutions require coursework in accounting, mathematics, and English, at some the specified courses are at the two-year terminal degree level and at others they are of the transfer-type.

Noteworthy aspects of the data processing curriculum core are:

* One institution requires a course in microcomputers.
* Two have required software systems courses.
* Three require courses in computer systems architecture.
* The number of institutions requiring given languages is as follows: COBOL, 12; RPG, 7; Assembler, 6; FORTRAN, 6; and BASIC, 3.
* Four schools include a required internship/cooperative education experience.

Potential employers of data processing graduates reported a rapidly accelerating shift in their hiring practices. These employers, especially the larger ones, are selecting the bachelor's-educated person with no data processing (computer science) knowledge over the two-year technically-oriented person.

Recommendations

The curricula of the data processing programs must produce well-qualified practitioners in the data processing field. In order to build upon and enhance the strengths of the current curricula of the programs, the Task Force recommends that

- The institutions continue heavy local involvement in curriculum development and find ways to help the local employers see beyond their present needs. (See also the recommendations below in the section on industrial relationships.)

- The institutions, whenever practical, structure course requirements so as to maximize transferability (articulation).

- Although not recommended as a "model" curriculum, present and planned data processing curricula should contain at least the following data processing core:

  * Programming logic, structured design, problem analysis
  * One language (COBOL) taught in depth and at least one additional programming language
  * Assembler language as a medium of instruction in machine architecture
  * Overview of systems architecture
  * Systems analysis
  * Software systems (operating systems, support environments, etc.)
  * Coursework in emerging technologies (currently micro-processors, application-based languages, office automation, etc.)
  * An internship/cooperative program

- The institutions, to meet the emerging needs of employers, must begin to shift some of the curricular emphases away from the near-exclusive emphasis on skills. As application-based languages and applications programs tailored to particular industries become readily available, the need for the current two-year graduates with only programming skills could diminish. If the colleges do not respond to this type of change, they may soon find that graduates are not employable.

Faculty

The qualifications of the community college faculty must be of major concern to the individual institutions and the VCCS because of their impact upon the quality of the program and student "occupational preparedness." In addition, faculty qualifications are relevant to such issues as articulation agreements, admissions, and faculty development.

The minimal criteria for initial appointment and for promotion for faculty

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within the VCCS are given in the Policy Manual.<2> Occupational experience in addition to academic training and prior teaching experience are of paramount importance in data processing programs.

Faculty Rank

A review of the faculty by rank indicates that 27% of the data processing faculty hold the rank of Instructor, 32% Assistant Professor, 24% Associate professor, and 14% Professor. A complete summary of the faculty by rank and institution is contained in Table 21.

Faculty Salaries

Data processing faculty salaries by community college and rank (Table 22) indicate that while the range for faculty of the same rank may be large, salaries tend to lie at the upper limits of the salary schedule set by the VCCS.

Academic Qualifications

The qualifications of the 56.5 full-time data processing faculty employed for the 1982-83 academic year vary widely. They range from questionably-qualified to highly-qualified, as reported in the institutional self-studies and the supplementary data provided by several institutions.

An analysis of the educational qualifications of the faculty indicates that 30% have completed only a bachelor's degree and 70% have completed a master's degree or beyond (Table 23). The full-time faculty who have completed the master's degree or beyond hold advanced degrees in a variety of disciplines. This variety prompts several questions. First, what is the actual number of credits in data processing countained in the various advanced degree programs? Second, for those degrees that pre-date the addition of data processing courses, what additional education has been completed to supplement this prior education?

<2>Richmond, Virginia Community College System Office. Frequently updated.

TABLE 21—Full-Time Faculty Teaching in Data Processing Programs, 1982-1983

Institution	Professor	Associate Professor	Assistant Professor	Instructor	Assistant Instructor	Total
Blue Ridge	0	0.5	0	1	0	1.5
Central Virginia	0	1	1	1	0	3.0
Danville	0	2	0	0	1	3.0
J. S. Reynolds	1	1	2	0	0	4.0
John Tyler	0	0	0	2	0	2.0
Northern Virginia	5	2	8	6	0	21.0
Piedmont Virginia	0	1	2	0	0	3.0
Southwest Virginia	0	0	0	1	0	1.0
Thomas Nelson	1	2	2	1	0	6.0
Tidewater	1	3	1	1	1	7.0
Virginia Western	0	1	2	0	0	3.0
Wytheville	0	0	0	2	0	2.0
Total	8	13.5	18	15	2	56.5

TABLE 22—Average Salary for Full-Time Data Processing Faculty by Rank, 1982-1983

Institution	Professor	Associate Professor	Assistant Professor	Instructor	Assistant Instructor
Blue Ridge		23,000		17,892	
Central Virginia	26,110	22,286	21,093	17,343	
Danville		24,462			10,650
J. S. Reynolds	22,780	23,411	19,908		
John Tyler				17,594	
Northern Va.<1>	26,923	22,903	18,437	16,379	
Piedmont Virginia		21,749	19,011		
Southwest Virginia				18,000	
Thomas Nelson	26,523	20,994	19,575	18,540	
Tidewater	22,075	21,861<2>	20,924	14,875	11,675
Virginia Western		24,175	18,725		
Wytheville				17,900	
VCCS Minimum Salary	20,640	18,505	16,370	14,335	10,675
VCCS Maximum Salary	28,470	25,625	22,775	19,930	14,235
VCCS Salary Range	7,830	7,120	6,405	5,695	3,560
Actual Range	4,848	3,181	2,656	3,665	1,025

<1>Salaries reported were for the 1981-1982 academic year.
<2>Calculated by the Task Force from institutional salary data.

Third, to what extent has the lack of academic preparation been supplemented by vendor training, in-house education, seminars, and the like?

Occupational Experience

Analysis of the occupational experience(s) of the full-time data processing faculty (Table 24) indicates that between 17.70% and 48.67% of the VCCS faculty

TABLE 23--Degree Qualifications of Full-Time Data Processing Faculty, 1982-1983

Degree Discipline	Educational Level		
	Bachelor's Only	Graduate Study Up To the Master's	Beyond the Master's
Accounting	1		
Business	1	1	
Business Admin.	1	3	
Business Education	1	6	
Business Management		3	
Computer Science	2	4	
Education		1	3
Engineering	1		
Management		2	
Mathematics	4	2	
Math. Education	1		
Mgt. Info. Sci.		1	
Public Adm.		2	
Unspecified	2	4	1
Total<1>	14	29	4

<1>Data on degree qualifications not available for all full-time faculty.

TABLE 24--Occupational Experience of Full-Time Data Processing Faculty, 1982-1983

Occupational Experience	Full-Time Faculty	Percent
Directly Related Experience	27.0	47.79
Business Related Experience	2.0	3.54
No Related Experience	10.0	17.70
Occupation Indeterminate or Not Reported	9.0	15.93
No Data Provided	8.5	15.04
Total	56.5	100.00

have been hired without having the specified experience. However, VCCS policy allows substitutions of academic training for occupational experience at the equivalency ratio of 30 credits per two years of occupational experience. It does not appear, however, that the lack of occupational experience is counterbalanced by excess of academic achievement. In addition, military assignment such as management work may have been inappropriately counted as related occupational experience.

Adjunct Faculty

Adjunct faculty are an essential element of the community college program, providing both (comparatively) inexpensive labor and a liaison with the community needs for graduates. Moreover, the adjunct faculty "program" can be a form of self-help on which the local industry can build and an effective source of future employees.

Despite the advantages offered by use of adjunct faculty, three significant problems arise from the use of such persons. First, with less time for preparation and less training in lesson-plan preparation and programming, adjunct faculty may find it difficult to provide the exact material prescribed in the syllabus. Second, with their knowledge of industry, there is a tendency by adjuncts to replace "mundane" topics in the syllabus with those experiences with which they are most familiar or find easier to teach. Adjunct faculty often are left to fend for themselves and have minimal contact with the full-time faculty or their fellow adjuncts. Attendance at regular faculty meetings would mean more time spent away from family or job but would provide needed opportunities to absorb the atmosphere of teaching and to better understand the administrative problems of operating an educational program. Third, the effective support of adjuncts by the full-time faculty increases the latter's work load.

Nowhere in any self-study did a community college expound on its work with adjunct faculty and the services which the institution provides to help them in their solitary task.

No survey of the qualifications of adjunct faculty was undertaken by the Task Force. However, because of the extensive use of adjunct faculty in the data processing programs, it is recommended that a such a study be undertaken by the institutions.

Faculty Development

Faculty development activities are of significance to community colleges, especially as a large percentage of the data processing faculty possess credentials at or below minimal standards. Faculty development is an encompassing term used to indicate a commitment on the part of a community college to support its faculty in the maintenance of their technical or academic currency. This commitment may take the form of providing funds for faculty members to attend conferences, seminars, and conventions; paying tuition for faculty to initiate and complete advanced degrees; allowing enrollment in selected courses in data processing at other educational institutions; or facilitating attendance at courses or activities offered by the professional training organizations. The funds for faculty development can be reflected in the budget in several ways, including direct allocations and compensation or in the form of released time and sabbatical leave.

The term "Educational Aid" is the community colleges' "label" for funds which the institutions provide to underwrite costs incurred by faculty when taking courses/degrees. As stated in the VCCS Policy Manual,

> All educational aid must be justified according to one of the following objectives:
> a. train employees in the use of new or modified methods and equipment;
> b. train employees in skills and knowledges required by changes in the employees' current positions;
> c. train employees for advancement to positions for which qualified applicants are not otherwise available;

d. train employees appointed with below-minimum qualifications because qualified applicants were not available;

e. enable qualified members of teaching and research staffs in educational institutions to attain advanced degrees when such degrees are essential to maintenance of established standards for the institutions; or, to enable such staff members to undertake research or advanced study necessary to meet specific needs within the duly authorized program of the institution.

Budgeted versus Expended Funds

Although there are comprehensive and extensive policies concerning "educational aid" at each community college, the individual institutions interpret these policies quite differently (Table 25). Several of the colleges treat educational aid as a non-priority item, while others attempt to provide an adequate level of funds. At one institution, at least, it was reported that it was relatively easy to obtain educational aid funds to take six credits of graduate courses prefixed "Education" or other formal courses but very difficult to justify attendance at a vendor workshop entitled (for example) "Introduction to Data Base Systems."

TABLE 25—Data Processing Faculty Development Funds, 1982-1983

Institution	Number of Full-Time Faculty	Amount Budgeted	Amount Expended	Average Amount Expended per Faculty Member
Blue Ridge	1.5	200	212	141
Central Virginia	3.0	NS	400	133
Danville	3.0	300	1,695	565
J. S. Reynolds	4.0	800	1,321	330
John Tyler	2.0	200	0	0
Northern Virginia	21.0	1,100	200	10
Piedmont Virginia	3.0	1,400	3,009	1,003
Southwest Virginia<1>	1.0	0	0	0
Thomas Nelson	6.0	1,900	708	118
Tidewater	7.0	784	1,603	229
Virginia Western	3.0	750	600	200
Wytheville	2.0	330	1,782	891

<1>Program initiated in Fall 1982.

The clearest evidence of reported commitment to faculty development appears in the allocation of five hours of released time at the "overload rate" given two faculty members to develop proficiency with the newly installed MUSIC interactive system and attendance at a MUSIC Users Workshop in Alabama, the allocation of $1357 to support activities associated with a leadership position in VAEDS and other professional organizations by one faculty member, and the allocation of $1000 for tuition for completion of a degree by one faculty member. Other expenditures of funds were primarily for travel or lodging for workshops or seminars associated with the implementation of MUSIC and membership in DPMA, VAEDS, and other professional organizations. Perhaps the most glaring evidence of the lack of institutional commitment is evidenced by seven of the eleven reporting institutions having spent an average of $200 or less per faculty member. (One institution reported no expenditure because its educational aid program is a new undertaking.)

In nearly every institutional self-study there was the statement or implication that reduced teaching loads for course or curriculum development for technical upgrading are not available. Faculty sabbatical leave policies, although part of every community college's publications, seem to be rarely available. One self-study, for example, stated that "for financial reasons the institution has not offered educational leave with pay in recent years."

Recommendations

An adequate number of qualified faculty are necessary to offer a strong curriculum for the students enrolled in the data processing programs. The Task Force recommends that

- The institutions, through a combination of salary and other incentives, attempt to recruit faculty whose qualifications are closer to those cited as minima in the VCCS-29. The role of community college faculty is to train students for positions as programmers and programmer trainees; specific occupational experience should not be overlooked in the qualifications of prospective faculty.

- The VCCS and the institutions recognize the difficulty in recruiting qualified personnel. This recognition could take the form of a salary differential for faculty in those teaching disciplines where the competition of the marketplace makes the standard salary schedule non-competitive.
- The institutions conduct self-studies for a greater period of time than that devoted to the current study to carefully evaluate the qualifications of the faculty and the requirements necessary for faculty to achieve technical currency.
- The institutions provide a minimum of $500 per data processing faculty member per year to underwrite the cost of professional development.
- The institutions facilitate such currently underutilized developmental activities as acquiring faculty internships, gaining professional certification, and attending regional- or system-sponsored workshops.

Virginia Community College Network (VCCN)

Until recently, most of the 23 community colleges satisfied their academic computing needs independently of one another, with only occasional instances where shared software or systems were utilized. Administrative computing was handled similarly, but with somewhat more sharing taking place. This largely decentralized approach resulted in the proliferation of computer hardware types and the redundant development of software. Moreover, as the need for computing services grew and the state-of-the-art in computer hardware and software improved, a more modern, integrated, cost-effective method of academic and administrative computing was sought.

The Master Plan for the Virginia Community College Systems Computing Services<3>, developed and approved in May 1981, purported to fulfill this need. It "set(s) forth the direction for providing computing services and satisfying data processing requirements for the Virginia Community College System during the decade of the 80's. Computing services include resources for both

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<3>Richmond: VCCS, May 1981.

administrative and academic computing," and were based on the concept of a four-level distributed computing network utilizing IBM compatible computer hardware (Appendix IV).

The model included a central general-purpose host computer connected to two Level-2 regional hosts for the sharing of data and processing functions. Each of the regional hosts, was, in turn, connected to a number of Level-3 college cooperative hosts which served as regional interactive processing centers for several community colleges. Level-4 colleges were to utilize unintelligent RJE stations and CRT's through which they could access any processor at a higher level in the network hierarchy. Thus, terminals located at Level-4 would have complete access to all levels of the Virginia Community College Network (VCCN). While the network composition and topography were changed in the progress of implementation in 1982, the intended uses remained the same.

The Master Plan included an ambitious listing of both academic and administrative services which the network was to serve (Appendix V). Little will be said here concerning administrative computing services. As for academic computing hardware applications, they are, of course, fundamental to the community colleges' ability to educate students in data processing curricula. The network-related recommendations are necessarily generic in nature because the network directly affects many academic departments. If left unattended, however, the associated problems will have a greater negative impact upon the data processing program than on any other instructional area. For this reason, the Task Force undertook a close review of the state of the development and implementation of the VCCN Master Plan.

At the time of the preparation of the self-studies by the community colleges (Fall Quarter 1982), the VCCN was in its initial stages of implementation. Consequently, all of the 12 community colleges offering degrees in data processing were in a state of transition from in-house computing facilities to the planned VCCN interconnection. The self-studies, therefore, contained many comments regarding the change-over difficulties encountered or anticipated in converting to a major shared computing network.

Finally, the Task Force did not consider it to be within its purview to assess the appropriateness of the Master Plan or its implementation approach. However, it did look at the current and anticipated ability of the network to meet the academic computing needs of the community colleges in a timely and cost-effective manner.

Findings

System User Expectations.

The Master Plan included a conceptual model of the VCCN which the designers felt would meet both the academic and administrative computing needs of the community colleges. What the plan lacked was specific information about the number and location of terminal devices available to, or required by, each of the community colleges now and in the future, and detailed descriptions of the processing capacity and functions available to the colleges via these terminal devices. The absence of this vital link between designers and academic users has already had a significant negative impact.

From the self-studies, it was apparent that the colleges were proceeding as though they would have almost limitless access to the mainframes and that the number of terminal devices which they might employ was not a major consideration.

On the other hand, by Spring 1983, the regional centers (four in number) had limited access to 80 terminal devices each. Long-term plans have been developed for the accommodation of 150 terminals per center, but this target appears to have been decided without extensive consultation with the users, and may well exceed the capabilities of the network as planned. Most institutions complained about inadequacy of facilities for student access, but none specifically complained about faculty access. The Task Force believes that VCCN access is equally applicable and necessary for both faculty and students and assumes that current faculty access is therefore equally insufficient.

The VCCS Chancellor and the Director of the VCCN told the Task Force that, although the network had been planned and designed as an integrated source of academic and administrative services, current staff and funding limitations, coupled with the urgency to support academic computing needs, have imposed a delay in implementation of the proposed computing resources. The result, they said, was the decision to concentrate on stabilizing the current academic computing services and to defer enhancements and the integration of administrative computing. This decision may account for many of the reported apparent hardware and software inadequacies in the support of the data processing programs.

Technical Support.

One of the underlying assumptions of the Master Plan was that there would be technical support personnel available from VCCS Data Services and VCCN Regional Centers to assist all network users in overcoming conversion trauma, program and system development/enhancement, and daily operational problem resolution. The self-studies revealed a wide-spread, almost universal, perception that the personnel resources currently available are far from sufficient in number to support either the administration of the network or its users. In addition, an assessment of current VCCS Data Services staffing revealed substantially fewer resources than originally proposed. The result has been less progress and greater user dissatisfaction than anticipated.

Cost.

The Master Plan projected that telecommunications costs previously required to interconnect community colleges to selected central support sites would be reduced with the new network. This was predicated upon the assumption that administrative and academic computing would be available to all network users utilizing a single distributed network topography.

By April 1983, the VCCN implementation had installed one Level-1 host, four Level-2 hosts, and two Level-3 cooperative processors (Appendix VI). None of these processors were interconnected in the manner originally proposed, although a Level-2-to-Level-3 test was projected for the near future to determine the viability of inter-level real-time passthrough of services. As a result, it is not apparent that the current implementation will achieve the expected telecommunications cost reduction upon which the network conceptual model was based. A similar scheme implemented in Minnesota five years ago has since been disbanded due to excessive communications costs.

Financial Reporting.

The Task Force requested that each institution provide a summary of ADP support costs at the curriculum level in its self-study. Based upon the quality of the responses, the Task Force concluded that the program heads at the community colleges, who must plan and budget for VCCN utilization and support, do not have the necessary financial data to select appropriate levels of network utilization in support of their various curricula. (See also the section on fiscal support, below.)

Organization and Control.

The Master Plan included detailed schema for the coordination and management of systems to support administrative and management requirements within the VCCN. That design is shown in Appendix VII. The Computer Services

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Planning Committee was assigned the responsibility for major projects and for administration of the network, including:

a) maintaining an updated computing services plan which is synchronized with system-wide planning and budgeting cycles
b) establishing priorities for systems development hardware/software acquisitions; and the acquisitions of other resources
c) appointing project teams and task forces to accomplish computing service objectives
d) reviewing progress towards completing Plan objectives and publishing an annual report
e) coordinating and recommending policies on major issues that affect the computing services and the VCCS
f) providing final recommendations on the settling of differences concerning project development efforts
g) maintaining an acceptable systems development methodology and approving guidelines and standards for all coordinated shared development projects
h) ensuring that the VCCS computing network provides an adequate level of academic computing resources and services to all 23 institutions.

This Planning Committee was to have included the Director of Data Services, operating heads of functional areas served by the VCCS, and members of institutions in the VCCS. Instead, a Presidents' Advisory Committee on Data Processing was established to provide advice to the Vice Chancellor on data processing matters. It is not apparent that this advisory committee provides an effective forum for representatives of the VCCS academic users.

Recommendations

The quality of the data processing programs is dependent upon the computing resources available to support the programs. To strengthen the capability of the VCCN to provide necessary academic computing services, the Task Force recommends that the VCCS

- Conduct an immediate and thorough review of total system academic data processing requirements, then select the computer technology/system architecture best able to meet those needs. It is imperative that the review be completed by Fall 1983, because the academic computing requirements of the community colleges are not now being met. As a result, some institutions are pursuing alternative sources of mainframe support while others are considering the procurement of numerous microprocessors to supplement the network.

The Task Force thinks that it is highly unlikely that the VCCN will ever meet the objectives for which it was established if the colleges are allowed to satisfy academic computing needs independently. Only though effective management control will the network be able to meet the needs and expectations of the system.

- Develop performance standards and management procedures which will clearly identify the levels of performance for which the VCCN is designed. The standards must include such things as definitions of the scope of services, terminal response time requirements, and especially a formal mechanism for bringing together the expectations of the network users and the network planners/developers.
- Establish a job accounting methodology which would clearly identify VCCN computing costs at the individual community college program level and provide sufficient data to permit realistic budget allocations at the colleges.
- Update the VCCN Master Plan to reflect revised requirements for terminals for both faculty and students, applications usage, program development, and computer and other network configurations. Fundamental to this recommendation is a clear understanding of the costs and performance requirements necessary to support the approved level of network function.

The Task Force is not suggesting that the question of the approach to the VCCN be reopened. Furthermore, no judgments on the efficacy of proposed deviations from the plan are offered. Such things should be decided by the VCCS after a thorough review of the system-wide academic computing needs. The Task Force believes that a totally decentralized computing system is not an appropriate alternative, however, given the commonality of VCCS computing needs and the efficiences inherent in many of the shared approaches. Moreover, only the larger colleges are capable of planning, staffing, administering, operating and funding the computing facilities essential to the provision of needed academic computing services.

Fiscal Support

The funds allocated to the data prosessing program can influence the quality of the program. Students enrolled in data processing courses, where there is inadequate equipment for the development and debugging of computer programs, generally receive qualitatively less than should be expected. Skills are developed through practice, and an institution which is forced to reduce the number or complexity of required student exercises due to a lack of hardware or software undermines the quality of its data processing offerings.

The amount of funding allocated to a program also indicates the priority assigned to that program by the institution. It must be remembered that the program costs for the AAS degree in Data Processing inherently will exceed the costs for all but the most equipment-intensive programs offered by an institution. The institutions' financial support of their data processing programs include expenditures for both personal and non-personal services (Table 26).

Analysis of the relationship between full-time faculty and adjunct faculty salaries reveals extensive use of adjuncts at several institutions. Considering that the average per-credit-hour full-time faculty salary is about 2.5 to 3.0 times that of an adjunct, it appears that at many of the institutions the full-time faculty teach less than half the credits offered. At one institution, full-time faculty may be teaching less than 25% of the credits offered.

It is probable that the relationship of the non-recurring to recurring hardware costs is greatly influenced and distorted by the purchase of hardware and support costs for the newly-implemented VCCS computing network.

Total salaries, hardware, and supplies and miscellaneous budgeted amounts are shown in Table 27. Analysis of these data indicates that the data processing program budget as a percentage of total college budget ranges from 2.7% at Thomas Nelson to 6.4% at John Tyler. The differences between colleges do not correlate with the relative differences in data processing enrollments. Perhaps this can be attributed to variations in the VCCS network-related expenditures. The relationship of salary budget to computer budget indicates wide variation

TABLE 26--Data Processing Program Budgets, Fiscal Year 1983

Institution	Salaries			ADP Hardware		DP Supply	Other and Misc.	Total Program Budget	Total College Budget
	FT Fac.	PT Fac	Supp't	Recurr.	1-Time				
Blue Ridge	31692	13280	10500	50545	26966	3000	6000	141983	3245300
Central Va.	60772	23303	NS	115394	9307	4992	0	213768	5140000
Danville	76700	16000	29644	17150	25920	4230	810	170454	4622940
JS Reynolds	86000	64288	9000	49000	26000	13000	0	247283	12000000
John Tyler	35188	63025	19000	100500	125000	10500	0	353213	5483000
Northern Va.	357606	478635	376755	517343	0	39100	0	1769439	42016462
Piedmont Va.	65000	34700	9500	25605	56330	5200	0	196335	4261420
Southwest Va	34083	12130	0	59247	22002	12700	0	140162	4593336
Tho Nelson	69458	29235	10497	48977	56744	9750	8112	232783	8775000
Tidewater	184796	85998	27935	224262	40250	50535	2071	615847	19799954
Va. Western	113830	16048	124068	151269	19245	10818	4192	439470	8092694
Wytheville	35650	10000	0	33076	10206	900	26950	116782	3336151
Total	1150785	846642	616899	1392368	417970	164725	48135	4637524	121366257

NS: Data not supplied by institution.

TABLE 27--Distribution of Data Processing Program Expenditures

Institution	Salaries		Hardware		Supplies & Misc		Total Expenditure
	Expenditure	Pct.	Expend.	Pct.	Expend.	Pct.	
Blue Ridge	55,472	39	77,511	55	9,000	6	141,983
Central Va.	84,075	39	124,701	58	4,992	2	213,768
Danville	122,344	72	43,070	25	5,040	3	170,454
J. S. Reynolds	159,288	64	75,000	30	13,000	5	247,288
John Tyler	117,213	33	225,500	64	10,500	3	353,213
Northern Va.	1,212,996	69	517,343	29	39,100	2	1,769,439
Piedmont Va.	109,200	56	81,935	42	5,200	3	195,335
Southside Va.	46,213	33	81,249	58	12,700	9	140,162
Thomas Nelson	109,200	47	105,721	45	17,862	8	232,783
Tidewater	298,729	49	264,512	43	52,606	9	615,847
Va. Western	253,946	58	170,514	39	15,010	3	439,470
Wytheville	45,650	39	43,282	37	27,850	24	116,782
Total	2,614,326	56	1,810,338	39	212,860	5	4,637,524

among the institutions: John Tyler and Southwest Virginia spent 33% of their program budget on salaries, in contrast to Danville's spending 72% on salaries. Finally, it is not clear from the data that the regional computing centers were able to separate those costs that they charge back to other institutions for provided services from the costs of their own administrative data processing activities.

Recommendations

The data processing programs are costly activities, and sound financial management of the programs is necessary to ensure the programs' continued viability. The Task Force recommends that

- The VCCS prescribe the use of a uniform system of data processing cost accounting. It is imperative that this system be understood by all academic computing users, especially departmental faculty, program heads, and division chairmen. Once this has been accomplished, the resultant data will provide a basis for meaningful decision-making on such topics as the cost effectiveness of the VCCN and the fiscal viability of existing or proposed data processing curricula.

- The institutions monitor closely their full-time and part-time data processing faculty ratio. Those institutions which choose to use a high percentage of adjuncts should pay particular attention to the added burden this places on full-time instructors vis-a-vis advising, coordination, and the like. Also, adjuncts typically need considerable professional development in the art of teaching, and this requires special funding.

Advisory Committees and Other Community Ties

The mission of a community college requires that close relationships be maintained between the institution and the local community which it serves. One of the methods which has been chosen by all twelve Community Colleges is to appoint a Data Processing Advisory Committee composed primarily of members of local companies. The advisory committee constitutes a valuable resource for professional advice to an institution in its search for adjunct faculty, locations for off-campus classes, locations for site-visits by students, employment opportunities, internship opportunities for students and faculty, and additional computer resources (freely available).

The Data Processing Advisory Committees are composed of differing numbers of participants and differing modes of interaction ranging from once-a-year meetings to quarterly curriculum review sessions. In several self-studies, it was apparent that the committees are used as approval organizations when new courses are being proposed or changes in the curriculum are being prepared.

Influence on Curriculum

The advisory committees are not reticent in suggesting services in the form of course offerings which the colleges can provide to their constituencies. In several instances the committees have requested (and received) changes to the curriculum to better satisfy their immediate needs.

This interaction should be treated with care, because it is not clear that the members of the advisory committees are chosen for their knowledge of both the data processing field and the educational processes. Not the least of the requirements for a data processing program is to provide a general educational program on which the graduates can build a future learning experience, thus preventing their technical obsolescence as the industry changes. Further, constant or repeated modification of a curriculum can create confusion among the students about current requirements and a lack of maintenance of a long-range plan for the data processing program within the general college curriculum.

Student and Faculty Internships

Practical experience is an essential element of any experimental science program both for the students and faculty. The involvement of students in practical experiences before graduation has a significant effect on the intensity of their fervor for the courses in which they are participating and gives them additional direction towards their career objectives. Local industry has several motivations to become involved in such programs: it can get an "edge" on the hiring of the students involved by both showing them the type of work in which they can be involved by completing their studies and by being able to evaluate prospective employees for their aptitude and actual performance.

From the students' point of view, internship programs can provide an entree to badly needed financial assistance in the second year of their studies and can bring some assurance of their eventual employability.

Care must be taken, however, to ensure that such internship experiences are meaningful and pertinent to the program in which the student is enrolled. That is, using internship students as data entry clerks when their goal is to become programmers or operators is a non-effective internship program.

A review of resumes of the full-time faculty revealed very few with formal qualifications (apart from industry short-courses) in the field of data processing and even fewer with any industrial experience other than occasional consulting. After some internship experiences, students may have more experience than their faculty. This puts the faculty at a considerable disadvantage and their credibility is seriously in question. At their meetings with the Task Force, several employer representatives expressed their sincere interest in working with the institutions to develop faculty internship programs. The individual institutions should be encouraged to investigate these opportunities.

On-Site Course Offerings

One mission of a community college is to provide educational services to the local community. While this is commonly accomplished by operating classes at the college, bringing a class to the potential students can often attract more students (though this does not seem to be a problem in the data processing field) and may improve the potential for sponsorship by the student's employer. Moreover, classes held on-site can be taught by adjunct faculty from that firm. Individual institutions will find both advantages and disadvantages to on-site classes.

Local Resources

Irrespective of the level of funding provided by the state or the proportion of the college budget assigned to the data processing program, there probably will never be a time when the colleges will have every resource needed to support the educational program. An inventory of local resources which are available to the program and which can be used to supplement the college facilities can be the difference between a mundane program and a program which reaches out into the community and which is up-to-date.

One of the self-study questions asked the institutions about their support from industry. The majority of the institutions responded "not applicable." Perhaps the institutions misunderstood the question; if not, then valuable resources are being overlooked.

Recommendations

Advisory Committees can play an important role in guiding the current activities and future direction of the data processing programs. The Task Force recommends that

- The VCCS develop a model set of guidelines for the establishment and program of work of Data Processing Advisory Committees.
- Attention should be given to the needs of local industry as expressed by advisory committees, but their suggestions should be tempered by the needs of a student's educational program and the long-range plans of the department and institution.
- The choice of members of the Data Processing Advisory Committee should be based not only on knowledge of the field but also on understanding of and appreciation for the educational process.
- The institutions make provision for faculty to participate in internship programs of their own.
- The institutions seek out local resources to supplement their data processing programs.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the general conclusions and recommendations of the Task Force. Other conclusions and recommendations, applicable to specific fields within the computer science discipline, are found in the previous chapters.

In presenting these conclusions and recommendations, the Task Force does so with the firm conviction that the computer science programs in Virginia's public institutions form a good foundation upon which systemwide quality can and will emerge. Although much of this report focuses on aspects of institutional or systemwide activities in the discipline which need to be improved, it must be emphasized that many other aspects are educationally sound and indicate the presence of quality.

Many of the Task Force's recommendations, whatever aspect of the educational activity they address, carry a high price tag. Both personnel and equipment for the computer science discipline are expensive, and both are needed if the programs are to be supported adequately and are to be of high quality. If Virginia is to move into, and remain a productive part of, the high technology society of the twenty-first century, then a major investment is required now by both the institutions and the state to ensure that graduates of this century possess the skills and competencies to be productive citizens in future years.

Curriculum

The curriculum of each program in the computer science discipline offered by Virginia's public institutions of higher education needs to be improved. Specific components of each program that should be improved and enhanced are identified in the preceding chapters. Other curriculum concerns span all programs; the most important of these is the need to expand the focus of the curriculum away from a nearly exclusive emphasis on skills. All of the programs need to strengthen the students' abilities to reason and to communicate as well as to achieve a level of computer literacy that can be adapted to a wide variety of structured processes. The Task Force recommends that

- Each institution review those portions of this report that are applicable specifically to its programs and resolve identified curricular problems.
- The institutions ensure that curricula in the computer science discipline maintain a balance between the technical and general aspects of a well-rounded higher education.

Model curricula for the various fields in the computer science discipline have been developed by the IEEE/CS, ACM, and DPMA. Although strict adherence to these models is neither necessary nor desirable in every instance, given the diverse missions of the institutions and the scope and purpose of their programs, the basic competencies identified by the models should be incorporated into the programs. Moreover, the institutions' offerings in this discipline, whether as a general education component or as a minor within programs in other disciplines, should be of an acceptable quality. The Task Force recommends that

- The institutions incorporate the broad recommendations of the professional organizations into their curricula.
- The Council of Higher Education, in considering institutional requests for new programs in the discipline, use the curriculum models of the professional associations in evaluating the instructional merits of the proposed programs.
- The institutions commit sufficient resources for the support of the general computing activities in the institution-wide curriculum to meet the requirements specified in the draft position paper of the ACM IEEE/CS.

There is a significant demand for computing programs by persons already holding a bachelor's degree in another discipline. This demand can be addressed effectively by a post-baccalaureate certificate program whose curriculum is approximately equivalent to the required courses for normal admission to a master's program in the discipline. The Task Force recommends that

- The institutions offer post-baccalaureate certificate programs in the computer science discipline.

Student internships or directed work experiences provide an important supplement to the academic curriculum and afford both an opportunity to strengthen specific skills and an awareness of the job environment. Although there is a practical limit to the number of students who can be placed and supervised in external job settings during their academic programs, this appears to be due primarily to lack of sufficient faculty to coordinate the activity. Large-scale employers of computer science professionals are generally supportive of the concept. The Task Force recommends that

- The institutions support student participation in internships and directed work experiences by identifying potential employer participants and providing sufficient faculty or other staff to coordinate the activity.

Facilities

Maintaining adequate computer support for programs in the computer science discipline is a continuing challenge for the institutions. Adequate terminal access and machine-time for students and faculty, adequate support personnel, and availability of computer resources (including micro-computers) and appropriate software are all absolute necessities in supporting the programs. Each of these components of the computer support environment is important and all are interrelated. Moreover, all aspects of computer support are expensive and have a major impact upon the institutions' operating budgets. The Task Force recommends that

- The institutions design and implement a continuing process to assess, plan for, acquire, and maintain an adequate academic computing environment.

The level of equipment support and access to computing resources must be improved significantly in all institutions that offer programs in the computer science discipline. Where computing power is provided at a central facility, public terminals and computer ports should be available to students (at least 20 hours a day, 7 days a week) on a scale of at least one per 15 students enrolled in each course where significant computing homework is assigned. Sufficient computational power should be available to permit the use of modern full-screen editors with a response time of less than one second when all ports are in use. When the preferred vehicle for computing is stand-alone or networked microcomputers, a sufficient number of these devices should be available to provide at least one per 15 students. The magnitude of this upgrade in computational facilities is clearly beyond the financial capabilities of individual institutions and can only be achieved through additional state funding. The Task Force recommends that

- The institutions begin immediately to acquire sufficient computational support to provide terminal access on a scale of at least one per 15 students. In determining the magnitude of the additional resources required to meet this goal, the institutions must recognize that computer science is not the only academic discipline making significant use of computers and that student use across all disciplines must be considered.

- The Council of Higher Education support institutional budget requests for extraordinary funding to support the upgrade in academic computer support.

A clearly identified source of assistance to the students and faculty who use computers in their educational programs must be available. When the computing equipment is departmental, an appropriate number of technical support personnel must be assigned the responsibility for maintaining the equipment and access to it. Where the computing equipment is available through a central facility, there must be an individual responsible for academic user services, supplemented by appropriate full-time support personnel and student assistants. The Task Force recommends that

- The Council of Higher Education determine the minimum personnel requirements for academic computer user services at each of the state-supported institutions of higher education and support institutional budget requests for additional personnel as required.

- The institutions assign sufficient personnel to provide adequate support for academic computing activities.

The state procurement procedure for computing equipment creates problems for all the institutions of higher education, whose academic programs cannot tolerate delays in acquisition of needed equipment and services. Although it is the general perception that delays in procurement occur primarily at the central agency level, within the Department of Management Analysis and Systems Development, it is possible that there are equal or greater delays within the administrative levels of the institutions. The Task Force recommends that

- The Council of Higher Education, together with the Department of Management Analysis and Systems Development, review the state procedures for the acquisition of computing equipment for instruction and research and make all possible revisions to reduce delays in the procurement process.

The acquisition of costly machinery is one of the most difficult aspects of maintaining adequate computer support for programs in the rapidly evolving computer science discipline. Adequate state support for the acquisition and maintenance of sufficient computing equipment to support the programs is an absolute necessity. Although non-General Fund support cannot, and should not, substitute for state appropriations at a level sufficient to support the programs, it can supplement the basic state funding and greatly enhance the programs' vitality. The Task Force recommends that

- The institutions actively seek non-General Fund support for the acquisition of equipment, either through donation or monetary grants.

The Virginia Community College Network (VCCN) is not now supporting the academic computing requirements of the community colleges. As a result, some institutions are pursuing alternative sources of mainframe support while others are considering the procurement of numerous microprocessors to supplement the network. It is highly unlikely that the VCCN will ever meet the objectives for which it was established if the institutions are allowed independently to satisfy their academic computing needs. To meet these needs, network standards must be developed that define the scope of services, terminal response time, and especially a formal mechanism for bringing together the expectations of the network users and the network planners. Revised requirements for terminal access by faculty and students, applications usage, program development, and computer and other network configurations must be developed to support the immediate demands of all VCCN users. The Task Force recommends that

- The Virginia Community College System conduct an immediate and thorough review of total system academic data processing requirements, and then select the computer technology/architecture best able to meet those needs.

- The Virginia Community College System develop performance standards and management procedures that will identify clearly the levels of service and performance required by the individual institutions. The management procedures must include a job accounting methodology that clearly identifies network computing costs at the individual community college program level and provides sufficient data to permit realistic budget allocations to the colleges in support of network activities.

- The Virginia Community College System update the VCCN Master Plan to reflect revised requirements for academic computational services at the individual community colleges. Fundamental to this revision must be a clear identification of cost and performance requirements necessary to support the approved level of network activities.

Faculty

Additional faculty are urgently needed for the programs in the computer science discipline. Not only are the current course and student contact loads of the faculty excessive, permitting too little time for research and professional activities, the continuing growth of enrollments in the discipline further stretch faculty resources beyond any acceptable limit. A significant portion of the faculty now teaching in the computer science discipline do not hold terminal degrees in the fields they teach, perhaps because the discipline is a recent development. For the same reason, the institutions find it difficult to recruit faculty holding terminal degrees in computing. The Task Force recommends that

- The institutions, in hiring faculty, give preference to those persons holding terminal degrees in the relevant fields of the computer science discipline.

- The institutions, in hiring faculty, consider appropriate occupational experience as an acceptable substitute for terminal degrees. In so doing, the institutions must ensure that the employment history of the potential faculty member is directly related to the curricular content of the program in which the faculty member will teach.

The difficulty in recruiting faculty holding terminal degrees in computing has caused many institutions to hire persons with academic credentials in other disciplines. There are many instances in which faculty with only the master's degree in computer science are serving effectively in undergraduate programs. The Task Force recommends that

- The institutions consider hiring persons holding the master's degree in computer science to teach courses at the baccalaureate-level or below. In such instances, the lack of the terminal degree should not be a barrier to future promotion or tenure.

Several institutions have indicated plans to retrain current faculty in other disciplines to teach in various fields of computer science. The retraining of current faculty, while serving to alleviate temporarily the need for additional faculty, should not become a permanent substitute for the recruitment of persons holding terminal degrees in the computer science discipline. The Task Force recommends that

- The institutions' retraining programs be developed in consultation with the existing computer science faculties and include, at a minimum, technical course material equivalent to the baccalaureate curriculum in computer science.

- The necessary studies of those faculty being retrained be done away from the home campus.

- The institutions impose the same criteria for employment, promotion, and tenure upon retrained faculty as are imposed upon newly-hired faculty.

The recruitment and retention of qualified faculty in the computer science discipline is a continuing problem for the institutions. Not only must they compete with the private sector for the limited number of qualified persons in this discipline, the minimum salaries required to attract new faculty often are higher than the current salaries of faculty in the same rank, and this affects adversely the morale of tenured faculty. Moreover, although the 1982 Appropriations Act included a special salary differential for highly competitive disciplines, including computer science, this salary increment was not passed on to computer science faculty in all institutions. The Task Force recommends that

- The Council of Higher Education review periodically national salary averages for professionals in the computer science discipline to determine whether faculty salaries in Virginia's institutions are competitive and recommend appropriate salary adjustments as necessary.
- The institutions apply all appropriated salary differentials as intended in order to maintain a competitive salary scale for faculty in the computer science discipline.

Another factor influencing the recruitment and retention of computing faculty is the restrictions imposed by salary ranges tied to academic rank. For those programs at or below the baccalaureate level, the Task Force believes it appropriate to hire faculty who have extensive occupational experience in lieu of terminal degrees in the discipline. It is the current practice of most institutions of higher education to limit eligibility for tenure (and hence promotion) to faculty holding the terminal degree, and this confines otherwise qualified faculty without terminal degrees to the lower end of the faculty salary range. Moreover, once tenured faculty reach the upper limits of the salary scale for their academic rank, their salaries tend to become increasingly non-competitive. The Task Force recommends that

- The institutions not restrict the salaries paid to faculty in the computer science discipline by the imposition of salary ranges tied to academic rank.

Tenure and promotion decisions in higher education generally are influenced by academic credentials and the research and publication activities of the faculty member. Traditional tenure and promotion criteria may not be appropriate for the relatively new computer science discipline. Heavy teaching loads and the lack of access to appropriate computing facilities limit the opportunities for faculty research, and much of the significant research in the discipline is large-scale and long-term, thereby reducing the level of publications. The Task Force recommends that

- The institutions review their tenure and promotion policies for the relevance of these criteria to the computer science discipline and adjust these policies where appropriate.

Opportunities for professional growth and research by faculty are essential to the quality of all computing programs in the state. It is of utmost importance that the faculty in this rapidly evolving discipline maintain currency in their fields, and this is best done through such activities as attending professional meetings and workshops, gaining and maintaining appropriate professional certifications, and active and continuing research projects. The Task Force recommends that

- The institutions allocate funds for professional development of faculty in the computer science discipline. These funds should support, at a minimum, attendence of each faculty member at one national professional meeting per year.
- The institutions allocate resources to support research by the faculty in the computer science discipline. These resources should include not only access to adequate computing facilities but also released time from instructional duties.

Recent private-sector employment experience by faculty in the computer science discipline varies greatly. Some faculty serve as consultants to business and industry, and other periodically seek short-term employment in various occupational settings. Such linkages between the academic faculty and the private sector both enhance awareness by academe of current technological practices and applications and provide opportunities for cultivating private-sector support for the academic programs. The Task Force recommends that

- The institutions actively encourage periodic work experiences by faculty in the private sector. Institutions that do not have established sabbatical leave programs should support summer work experiences for faculty and establish personnel exchanges between the institutions and local employers of computer science professionals.

Adjunct faculty are involved in many programs in the computer science discipline. Although part-time faculty can alleviate temporarily the need to hire additional full-time faculty and bring specific competencies and technical expertese to the programs, they typically need considerable professional development in the art of teaching. The presence of a large number of adjunct faculty in a program places additional responsibilities upon the full-time faculty vis-a-vis advising, curriculum coordination, and the like. The Task Force recommends that

- The institutions monitor closely the number of adjunct faculty teaching in the computer science discipline and the impact of these adjunct faculty upon the workloads of the full-time faculty.

Students

The attractiveness of the computer science discipline has led to a rapid growth of enrollments in all fields of the discipline. This growth is driven partly by students who desire only to obtain a measure of literacy in the discipline. These expanding enrollments not only overwhelm the resources available to support the programs but also make it difficult for matriculated students to enroll in specific courses whose class size are limited by the availability of instructional staff and facilities. The Task Force recommends that

- The institutions develop program admissions standards for the screening and selection of applicants to computing programs. Such standards must identify those applicants most qualified to complete successfully the degree programs.

- The institutions place restrictions on the number of qualified students to be admitted to the programs based upon the availability of instructional staff and sufficient student access to academic computing resources.

- The institutions prevent the erosion of support for the computer science degree programs by developing separate courses for those students who desire only to achieve computer literacy.

Many of the applicants for admission to computing programs have inadequate preparation in mathematics, the basic sciences, or other requisite fields. This impedes their progression through the core curricula and reduces greatly the probablity of successful completion of the programs. The Task Force recommends that

- The institutions communicate to high school counselors and the Virginia State Department of Education the minimum preparation required of applicants for admission to computing programs and work closely with the high schools to ensure that prospective students in these programs receive adequate instruction at the secondary level in mathematics, the basic sciences, and other relevant fields.

- The institutions consider raising the minimum grade for successful completion of each core or prerequisite course in the computing curriculum to "C."

Library Resources

The Library collections of the four-year state-supported institutions in the computer science discipline generally are weak. At a minimum, the collections must include up-to-date monographs and journals. The transactions of the IEEE Computer Society and the Association for Computing Machinery, together with selected publications of the major national research organizations, are also essential. The Task Force recommends that

- The four-year institutions re-allocate funds to strengthen library holdings in the computer science discipline.

Administration of the Programs

The administration of programs within the computer science discipline is most effective when the programs are housed in independent departments. Such an administrative structure, however, is not always practical. The Task Force recommends that

- Each institution, where possible, establish an independent department to house each field within the computer science discipline.

- Each institution, at a minimum, establish for each academic program a clearly defined position of coordinator who has responsibility for administration of the academic resources and support services.

Effective administration of programs in computing depends in large part upon a clear recognition of the costs of instruction and computational support associated with the discipline. Accurate and timely cost data provide the basis for meaningful planning for, and control of, the academic programs and one means for assessing the efficiency of computational support services and providing students and faculty with a better understanding of computing costs. The Task Force recommends that

- The institutions establish job accounting systems that can be understood by all academic computing users, and especially by faculty and academic administrators at all levels.

Advisory committees provide useful assistance in the planning and monitoring of academic programs. Such committees offer the perspective of employers of computing professionals and can articulate the present and future competencies required by program graduates in the job market. When composed of persons having not only a broad knowledge of the discipline but also an understanding of and appreciation for the educational process, advisory committees make valuable contributions to the support of the programs. The Task Force recommends that

- Each institution have an advisory committee for each of its programs in the computer science discipline.

Continuous evaluation of the academic programs is essential for the maintenance of quality. Review of the career paths of program graduates and the assessment of employers' evaluation of the programs assists greatly in curriculum planning and revision, as the production of well-prepared practitioners is of vital importance to the long-term vitality of the programs.

Given the rapid evolution of computer technology, periodic evaluation of faculty technical competencies can identify specific subject areas that can be addressed only through additional faculty or further study by current faculty. Continuous assessment of institutional academic computing resources is necessary to ensure that computational facilities are adequate to support the programs (as recommended above). The Task Force recommends that

- Each institution develop and initiate a process for the continuing evaluation of its programs in the computer science discipline that includes the tracking of employment performance of program graduates and employers' assessment of the graduates' competencies.

The titles of programs in the computer science discipline offered by Virginia's state-supported institutions often bear little relationship to the programs themselves. The proliferation of diffuse program titles is confusing to students and employers and may well inhibit the effective recruiting of qualified faculty. The Task Force recommends that

- The Council of Higher Education and the institutions immediately revise the titles of programs in the computer science discipline to reflect accurately the scope and intent of the programs. Other than in extraordinarily exceptional circumstances, all programs at or above the baccalaureate level should be titled either "Computer Science" or "Management Information Systems." Use of these titles at the associate level should be limited to college-transfer programs that clearly articulate with baccalaureate programs at senior institutions; all other associate level programs should be titled "Data Processing."
- Each institution should review its commitment to providing a full program in one or more fields of the discipline, and, if the current activity is is not a full-scale curriculum but rather a major within a mathematics, business administration, or other program, the institution should withdraw the program title from its inventory.
- The Council of Higher Education insist that any programs it may approve in the future carry titles that clearly delineate their content and purpose.

The Task Force believes that this quality assessment of the computer science discipline in Virginia's public institutions will be useful to both the institutions and the Council of Higher Education. As these bodies review, plan, and implement the Task Force's recommendations, they probably will have questions about the Task Force's perspective on various aspects of the statewide activities in the discipline. The Task Force therefore suggests that

- The Council of Higher Education appoint a transition team, composed of three volunteers from the Task Force, to respond to questions that may arise as the Council and the institutions review this report and implement its recommendations. Members of this team would serve at the pleasure of the Council for as long as may be deemed appropriate.

APPENDICES

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APPENDIX I

SUMMARY OF COMMENTS BY EMPLOYER REPRESENTATIVES

Meetings were held by the Task Force on Computer Science on February 2, and March 25, 1983, with representatives of employers of computer science professionals in Northern, Central, and Tidewater Virginia. A total of 31 representatives participated in these meetings at which they discussed their assessments of the graduates from computing programs in Virginia's institutions of higher education. The representatives also assessed the overall quality of the academic programs, summarized their needs for future computing graduates, and provided recommendations for the enhancement of existing programs.

The employer representatives generally agreed that:

1. Existing programs in the computer science discipline are producing graduates who are able to adapt to a broad variety of applications and to new developments in computer technology and supporting techniques. These programs are fairly consistent and the expectations of both graduates and employers generally are met.
2. The community colleges should continue to concentrate their efforts toward developing student proficiency in computer-related skills such as computer operations, data entry, and computer programming, whereas the senior institutions should continue to emphasize computer-related concepts such as systems analysis and design and the development of fundamental logic skills.
3. All programs would benefit from placing additional emphasis on: interpersonal communications; the structure and discipline required for industry application of computer science; broad-based computer literacy, including interdisciplinary training (cross pollination); and adaptability (general education). Also recommended is the addition of

more in-depth computer knowledge and skills development for management information systems programs.

For applications systems positions, the employer representatives indicated a general preference for four-year graduates over two-year graduates, regardless of the amount of prior specialized computer training. They felt that four-year graduates have greater long-term potential due to a broader base of fundamental knowledge and they were prepared to provide the necessary additional specialized, computer-related skills through on-the-job training.

Specific recommendations, in priority order, for the enhancement of existing programs were:

1. Analytical and design skills: the ability to analyze large complex systems and to keep a systems perspective while working on a specific sub-element or task.
2. Real world orientation: the business aspects of applying the computer science discipline to the marketplace, including the ability to understand the relationship between project costs and benefits, the need for control and discipline, the recognition of user needs, project life cycle methodologies, and the maintenance of software systems.
3. Interpersonal communication skills: the ability to speak, write, and listen effectively, think, recognize and address an audience's perspective, and understand human communication and interaction.
4. Emerging technologies: the understanding of fourth generation languages, microprocessors, process control, CAD/CAM, data base, and networking.
5. Adaptability: the ability to accept and understand new or different approaches, languages, hardware architectures, and techniques, and to apply them in the solution of problems.
6. Computer literacy: the ability of individuals in all disciplines to

understand and apply the computer as a tool to accomplish productive work.

7. Internships/cooperatives: incorporation of real work experience into student curricula in cooperation with industry, and, for faculty, internships to assure currency in the industry applications of the computer science discipline.

APPENDIX II

DRAFT

POSITION PAPER

Computer Science Program Requirements

23 October 1982 (initial)
1 December 1982 (revised)
14 January 1983 (revised)

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To be Reviewed by: All members of the Joint ACM/IEEE Task Force for Computer Science Program Accreditation

Review to be Completed by: 14 February 1983

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Revised Draft Position Paper
Computer Science Program Requirements

1.0 INTRODUCTION

The professional societies should provide guidance and evaluation for computer science degree programs. Such guidance and evaluation should lead to the development of professional competence. Certain guidance and evaluation mechanisms and agencies exist for specialized programs such as computer engineering. The discipline, however, is very broad and expansive. It is estimated that as many as 500 programs are not currently served by existing mechanisms.

This position paper defines minimum quantitative criteria for undergraduate computer science programs. These criteria emphasize a philosophy of curriculum content and instructional environment rather than specific course material.

2.0 COMPUTER SCIENCE CURRICULUM

2.1 Introduction

The curriculum will integrate technical computer science requirements with institutional requirements and electives to prepare the student for a career in the computer field and for further study in computer science. The curriculum, subject to additional specifications given below, should consist of approximately one and one-half years of study in computer science, one year of study in supporting disciplines, one year of study in general education requirements, and one-half year of elective studies.

2.2 Computer Science

The computer science segment of the program should consist of a broadly based core of from 40% to 60% of the computer science requirements whose emphasis is evenly spread over the areas of computer theory, algorithms, data structures, programming concepts and languages, and computer elements and architecture. Within this portion of the program, emphasis is to be placed on analysis and design work with laboratory experiences receiving a strong emphasis. In addition the student needs to gain exposure in a variety of programming languages and systems, and become proficient in at least one high-level structured language. The social implication of computing should be included in the program.

The remaining 40% to 60% of the computer science segment of the program should be advanced courses in computer science. These courses are to be selected in such a manner to ensure that depth of knowledge is obtained in at least half of the core material.

2.3 Supporting Disciplines

Certain areas of mathematics and sciences are fundamental for the study of computer science. As such these areas must be included in all programs.

The curriculum should normally include one-half year of study of mathematics. This material includes discrete mathematics, differential and integral calculus, probability and statistics, and at least one of the following areas: linear algebra and matrices, numerical analysis, modern algebra, or differential equations. It is recognized that some of the material may be included in the offerings in computer science.

The curriculum should normally include two course sequences in basic or engineering sciences for science majors. It is preferred that one of these sequences be physics.

2.4 General Education

Courses in the humanities, social sciences, and other disciplines are normally specified by institutional requirements and serve to broaden the background of the student. In addition the communication skills of the student, both oral and written, must be developed.

2.5 Electives

The program is rounded out by a selection of free electives. The student should be encouraged to select a course sequence to provide an in-depth understanding of an area to which the techniques of the computer field may be applied.

3.0 FACULTY REQUIREMENTS

The strength of a computer science program lies with its faculty. A minimum of five full-time equivalent faculty, of which four should be full-time with primary commitment to the program, is required to adequately implement and continue to offer the core area material. It must be recognized that this criterion will be affected by the demand for additional offerings by the department. The use of adjunct faculty is encouraged, but only in a supplemental role for specialized courses to enhance the program. To insure both quality and continuity in the program, the coverage by adjunct faculty should not exceed 20% of the total teaching load.

The professional competency of the faculty must span a broad range of interests in computer science. It is highly desirable that a preponderence of the faculty hold the terminal degree. Further, they must be sufficiently competent in computer science to be able to teach all undergraduate courses in the field and can make a scholarly contribution to the computer science discipline. Adjunct faculty must be demonstratably qualified.

It is expected that all faculty members remain current in their profession, and that some of them are regularly contributing to the discipline.

4.0 FACULTY LOADS

Due to the fact that computer science is a dynamic, rapidly expanding field, faculty members must have sufficient time for scholarly activities and professional development. The average teaching load should not exceed 60% of the total individual effort. Additionally, on the average, 25% of the faculty time should be devoted to scholarly activities. In no case should teaching loads exceed the equivalent of 90% of the total effort of an individual faculty member, which in turn implies that teaching loads never exceed the equivalent of 12 semester credits, and if they do become this high, the load should not exceed four courses and two preparations. It must further be recognized that in this worst case scholarly activity cannot be expected of the faculty member.

Upper division class size should not normally exceed 30 students per faculty member although it is recognized that classes of greater than 30 can be handled with appropriate resources such as teaching assistants and graders. Lower division classes may be larger, but effective interaction between faculty/teaching assistants and students must be attained. Faculty advisors should counsel no more than 25 undergraduate students. Faculty should have adequate support services, such as secretarial, word processing, and copying.

5.0 STUDENTS

The quality of any program is strongly dependent on the quality of the students enrolled in the program. There must be a means of insuring the quality of students entering the program from within the institution and for transfers from other institutions. The most effective means of accomplishing this quality control is for the faculty in the program to set admission standards for both types of potential students. Specific admission and transfer standards and criteria must exist within the department. Students entering from high school should be able to enter the calculus course and a non-remedial English course in the first semester of residence.

Provisions must exist to insure that the student quality is maintained throughout the program. It is the responsibility of the faculty to provide proper advisory functions to assist the students in selecting an appropriate program, however responsibility for an individual program ultimately resides with the student. The administration must recognize the importance of the advisory function and provide the necessary support.

Self analysis of the programs is an important function of the faculty. Measures of the quality of student performance in the program includes the faculty monitoring examples of student work including examinations, homework assignments, project reports, and laboratory reports. The latter two categories provide both a measure of the communication skills of the students and their technical competence. Less quantifiable but still useful, measures of student quality include reports on post-graduate experiences.

6.0 INSTITUTIONAL SUPPORT

6.1 Introduction

The organizational structure, fiscal policies, and instructional philosophy of an institution must be such that they support the following:

a. Recruitment and continued support of a well-qualified faculty.

b. Recruitment and continued support of well-qualified administrators.

c. Acquisition and maintenance of modern laboratory equipment, including computing equipment, and associated support personnel.

d. Creation and maintenance of a library including qualified professional librarians, technical and non-technical support personnel.

e. Provisions for sufficient secretarial support, office equipment and maintenance of such equipment.

6.2 Faculty Support

The characteristics and qualifications of well-qualified faculty are covered in an earlier section of this report. Factors which affect recruiting and retaining these faculty include salaries, sabbatical and other leave programs, travel support, equipment and facilities, and research support. The policies of the institution must be such that the faculty are paid competitive salaries. Sabbatical and other leave programs are not only important in attracting faculty but are also a useful means of maintaining quality faculty. Travel support sufficient to allow each faculty member to attend, at a minimum, one national technical meeting a year is essential. Support and recognition of research and other scholarly activities is essential in attracting and maintaining the faculty necessary for a quality program.

6.3 Administration

All levels of the college/university administration are relevant to the program. Positive constructive leadership by the dean of the college/school and the head/chairperson of the department is important in maintaining program quality. For a department of 5 full-time equivalent faculty a full-time had/chairperson, with faculty status, is expected to devote approximately 75% of total effort to administration. Appropriate increases in administrative effort are necessary with increases in faculty and students. At a minimum the departmental administrative support should be proportional to other departments at the institution and in most cases should be greater because of the need to interface to industry and the laboratory nature of the discipline. Upper levels of administration must provide the program with the resources and atmosphere to function effectively with the rest of the institution.

6.4 Laboratory and Computing Resources

These resources will most likely be provided by a combination of central facilities and school/college/department facilities. Minimally adequate facilities must include interactive stations provided by time-sharing systems or personal computers. Microcomputers and minicomputers provide hands-on experience and have become an important part of most programs. The exact nature of the computers available will be influenced by the research activities of the faculty.

Appropriate equipment must be available for the research activities of the faculty and the instructional needs of the students. Minimal software support for the program includes at least one block structured language, one or more languages in "common use", one or more assembly languages, operating systems, and a DBMS system. Students must be supplied with appropriate expendables, which are, in effect, "the test tubes" of computer science. Complete documentation of the available hardware and software must be readily accessible to faculty and students. In addition, it is critical that adequate support personnel are available to implement and maintain this aspect of the program.

6.5 Library

It is strongly recommended that the library that serves the computer science program be staffed with an adequate number of professional librarians. Sufficient financial support must be provided to maintain an adequate technical and non-technical collection. The technical collection must include up-to-date textbooks, the journals, transactions and magazines of the IEEE Computer Society and the Association for Computing Machinery, and some of the major research organizations in the United States. The collection should include a representative number of trade journals.

6.6 Office-Secretarial Support

The institution must provide modern office equipment such as word processors and duplicating equipment. In addition, adequate secretarial support, which may vary with the type of program, level of research activity, and so forth, must be provided. At a minimum, there should be one secretary per five faculty members.

7.0 INNOVATIVE PROGRAM

The above guidelines are not intended to restrict experimentation. Innovative and forward-looking programs are encouraged. Flexibility in meeting changing situations, as well as needs of a variety of students, and the local environment are to be encouraged.

Appendix III

CREDIT HOURS AT COMMUNITY COLLEGES

Core Courses	Blue Ridge	Central VA	Danville	J.S. Reynolds	J. Tyler	Northern VA	Piedmont	Southwest	T. Nelson	Tidewater	VA Western	Wytheville
Intro to DP/Prin.	3	3	4	3	3	3	3	3	3	4	3	3
Com. Prog. (Concepts)	3(144)	3(144)	–	–	3(124)	3(124)	–	–	–	3(144)	3(144)	3(144)
Flowcharting & Logic	–	–	–	3	–	–	–	–	3	–	–	–
COBOL I	3	3	4	4	4	4	3	3	4	4	3	3
COBOL II	3	4	4	4	4(ADV)	4(ADV)	4	4	4	4	4	3
COBOL III	3	4	4	4	–	–	4	4	4	4	4	3
FORTRAN	4	4	4	–	–	–	–	3	–	–	4	4
Advanced FORTRAN	–	4	–	–	–	–	–	–	–	–	–	–
ASSEMBLER	–	4	4	4	–	4	–	4/ELECT.	–	–	4	4
Advanced ASSEMBLER	–	4	–	–	–	–	–	–	–	–	–	–
BASIC	–	3	–	–	–	–	3	–	–	–	–	3
RPG	4	4	4	–	–	–	–	4	–	4	4	4
JCL	–	–	–	3	–	–	–	–	3	–	–	–
Systems Analysis I	3	3	3	3	3	3	3	3	3	3	3	3
Systems Analysis II	–	3	3	3	3	–	3	3	3	–	3	3
Systems Analysis III	–	3	–	–	–	–	3/ELECT.	3	–	–	3	–
Data Base Mgmt.	–	–	–	–	–	–	–	4	–	4	–	–
Com. Prog. Applications	4	–	4	4	4	4	–	–	4	4	4	–
Keypunch/Keytape	–	–	–	–	–	–	3*	–	–	–	–	–
Com. Software Systems	3(287)	–	–	–	–	3(287)	–	–	3(287/ELECT.)	–	3(130)**	–
Com. Sys. Architecture	–	–	–	–	3	3	–	–	–	–	3	–
Intro. to Mini's	–	–	–	–	–	–	–	3	–	–	–	–
Electives	3	–	–	4	14	4	3	3	10	–	–	6
Subtotal	38	49	38	39	41	35	32	44	44	34	48	42
Seminar & Project	–	–	1–5	1–5	2	4	–	–	–	–	–	–
Cooperative Ed./ELECT.	–	3	–	–	–	–	9–12	–	–	6–12	–	3
Core Total	38	52	39–43	40–44	43	39	41–44	44	44	40–46	48	45
TOTAL (Core+Non-Core)	97	97	94–98	98–102	98	97	96–99	104	100	97–103	97	96
AAS Requirements	97	97	97	98	98	97	97	104	100	97	97	96

---

*Credit can be met via competency exam.

**DAPR 130 – Operating Systems

/ELECT – or Elective

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Appendix III(cont.)

CREDIT HOURS AT COMMUNITY COLLEGES

Non-Core Courses	Blue Ridge	Central VA	Danville	J.S. Reynolds	J. Tyler	Northern VA	Piedmont	Southwest	T. Nelson	Tidewater	VA Western	Wytheville
Accounting I	4	4	4	3	4	3	3	4	3	3	3	3
Accounting II	4	4	4	3	4	3	3	4	3	3	3	3
Accounting III	4	–	4	3	4	3	3/ELECT.	4	–	3	3	3
Cost Accounting	–	–	3	–	–	–	–	3	–	–	3/BUS FIN	–
Acct. Supervised Study	–	–	–	–	..	–	–	3*	–	–	–	2
Intro. to Business	3	–	3	3	3	3	3	–	3	3	–	–
Mgmt. Principles I	3(164)	3(164)	3(166)	3(164)	3(164)	3(164)	–	–	3(114)**	3(164)	–	–
Mgmt. Principles II	–	–	–	–	–	–	–	–	–	3(165)	–	–
Economics	3	3	3	3	3	3	3	3	3	3	3	3
Bus. Statistics I	3	3	3	3	3	3	or Math I	3	3	3	3	3
Bus. Statistics II	3	–	3	3	3	3	or Math II	3	–	–	–	3
Marketing	–	–	–	–	–	–	3	–	–	–	–	–
Prod. Plan. & Control	–	–	–	–	–	–	3	–	–	–	–	–
Business Law	3	–	–	–	–	–	–	–	–	–	3	–
Business Finance	–	–	–	–	–	–	–	–	–	3/ELECT.	–	–
Math I	3 M151	3 M101	3 M101	3 B121	3 B121	3B121/M101	3 M191	3 M161	3 M151	3 B121	3B121/M181	3 M181
Math II	3 M152	3 M102	3 M102	3 B122	3 B122	3B122/M102	3 M192	3 M162	3 M152	3 B122	3B122/M182	3 M182
Math III	–	3 M103	–	–	–	–	3/ELECT.	3 M163	–	3 B123	3B123/M183	3 M183
English I	3	3	3	3	3	3	3	3	3	3	3	3
English II	3	–	3	3	3	3	3	3	3	3	3	3
Eng. III/Tech. Writing	3	3 (TW)	–	–	3 (TW)	–	–	3	3	3	–	–
Reading & Study Skills	–	3	–	–	–	–	–	2 (ADV)	–	–	–	–
Oral Communication	3	–	3	3	3	3	3	–	3	–	3	3
Business English	–	–	–	3/ELECT.	–	–	–	–	3	–	–	–
Human Relations/Psyc.	3	3	3	3	3	3	3	3	3	3	3	3
American Government	3	3	3	3	3	3	3	3	3	3	3	3
Personal Typing	–	–	–	–	–	–	–	3	–	2	–	–
Orientation	1	1	1	1	1	1	1	1	1	1	1	1
Electives	3	–	–	6	–	9	6	–	7	–	–	6 (BUS)
PE (1, 2 & 3)	3	3	3	3	3	3	3	3	3	3	3	3
Non-Core Total	61	45	56	58	55	58	55	60	58	57	49	54

---

*Computer Augmented Accounting or elective.

**Principles of Supervision.

/ELECT = or Elective

M = Math

B = Business Administration

BUAD 121, 122, 123 = Introduction to Business Math

MATH 101, 102, 103 = Fundamentals of Math

MATH 151, 152 = Introduction to Business Math

MATH 161, 162, 163 = College Math

MATH 181, 182, 183 = General College Math

MATH 191, 192 = Finite Math

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Appendix III (Continued)

DATA PROCESSING CORE COURSES REQUIRED BY COMMUNITY COLLEGES OFFERING AN AAS IN DATA PROCESSING

Core Courses	Number of Colleges
Introduction to DP or DP Principles	12
Computer Programming (Computer Concepts	7
Flowcharting and Logic	2
COBOL I	12
COBOL II	12
COBOL III	10
FORTRAN	6
Advanced FORTRAN	1
ASSEMBLER	7*
Advanced Assembler	1
BASIC	3
RPG	7
JCL	2
Systems Analysis I	12
Systems Analysis II	9
Systems Analysis III	4*
Data Base Management	2
Computer Programming Applications	8
Keypunch/Keytape and Unit Record Operations	1**
Computer Software Systems	4***
Computer Systems Architecture	3
Introduction to Minicomputers	1

---

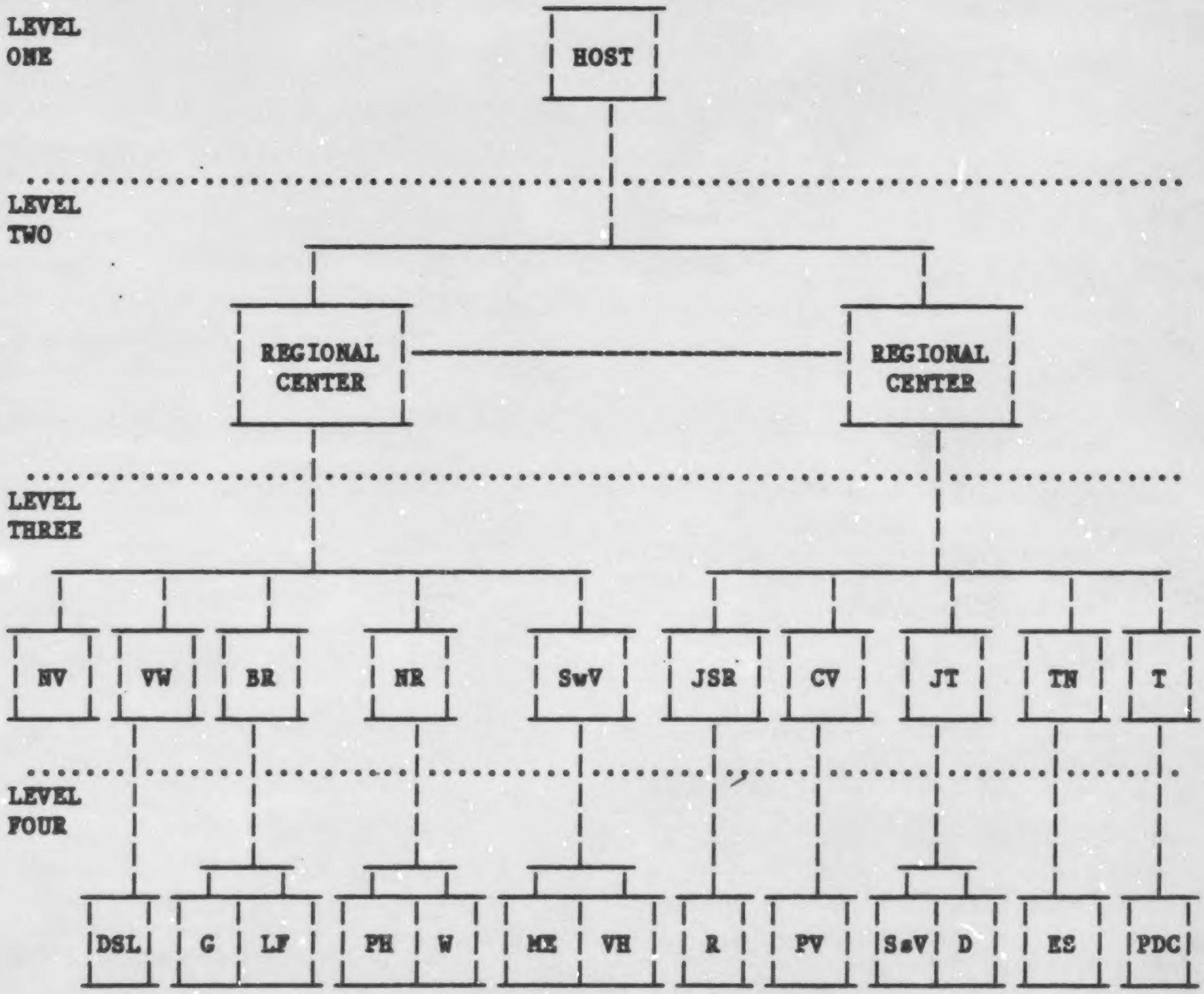
*One of the colleges requiring this course allows a substitute elective.

**Can be met by competency exam.

***One of the colleges requiring this course allows a substitute elective and one offers DAPR130 instead of DAPR287.

APPENDIX IV

DESIGN OF THE VIRGINIA COMMUNITY COLLEGE NETWORK (VCCN)


LEVEL ONE
HOST
LEVEL TWO
REGIONAL CENTER
REGIONAL CENTER
LEVEL THREE
NV
VW
BR
NR
SwV
JSR
CV
JT
TN
T
LEVEL FOUR
DSL
G
LF
PH
W
ME
VH
R
PV
SsV
D
ES
PDC

Relative Sizes

Level One	Central Host	370/158 Equivalent
Level Two	Regional Host	370/148 Equivalent
Level Three	College Center	370/138 Equivalent
Level Four	College/Campus	3776/77 Equivalent

Note: It is important to emphasize that size and number of computing installations and their location are subject to change in the final network configuration.

APPENDIX V

VCCN ACADEMIC AND ADMINISTRATIVE SUPPPORT SERVICES

Summaries of the academic support requirements and administrative applications identified in the VCCN Master Plan are listed below.

Academic Support Requirements

1. Instruction in Data Processing Technology--Computer Programming, Systems Analysis, Management of Computer Operations, and Related Studies.
2. Computer Managed Instruction--The use of a computerized test library and testing capability for individual student, testing, evaluation, and specific prescription for further study. Also, includes such items as processing of qualifying examinations, generation and maintenance of test banks, validation of test questions, and grading.
3. Problem Solving--The use of the computer for its computational capacities to set up and solve problems and equations in the natural, mathematical, and social sciences, and in applied fields such as business economics and engineering.
4. Tutorial Instruction--The use of the computer on an interactive basis to provide dialogue with the student, involving student responses to posed statements or questions, drill and practice, and computer-generated evaluations and feedback. Involves techniques traditionally associated with computer assisted instruction (CAI) and programmed instruction.
5. Simulation--The use of the computer to simulate conditions or situations in the various disciplines and fields of study and provide working computer-generated models for instructions. Examples of such simulation would include management problems with a number of related variables,

engineering applications in construction or architecture, highway and traffic control, and scientific experiments not practical in the laboratory due to considerations of safety or instrumentation.

Administrative Applications

Student Information
- Admissions
- Registrations
- Student Record Folder
- Financial Aid
- Veterans
- Counseling
- Graduation
- Alumni
- Health Services
- Job Placements
- Grading/Transcripts
- Student Finances
- Student Obligation
- Career/Academic
- Student Activities

Student Reporting
- Community Resources Analysis
- Data Element Dictionary
- Industrial Training
- Financial Accounting
- Local Funds Accounting
- Budgeting
- Purchasing
- Equipment Inventory
- Supplies Inventory

Personnel
- Applicant Processing
- Personnel Management
- Organization and Position Management
- Course/Schedule Interface
- Leave Management

Payroll
- Community Education
- Continuing Education Unit
- Public Service Activities

Course/Schedule Management System
- Course Dictionary
- Course Management
- Quarterly Class Schedule
- Faculty Management

Facilities Management

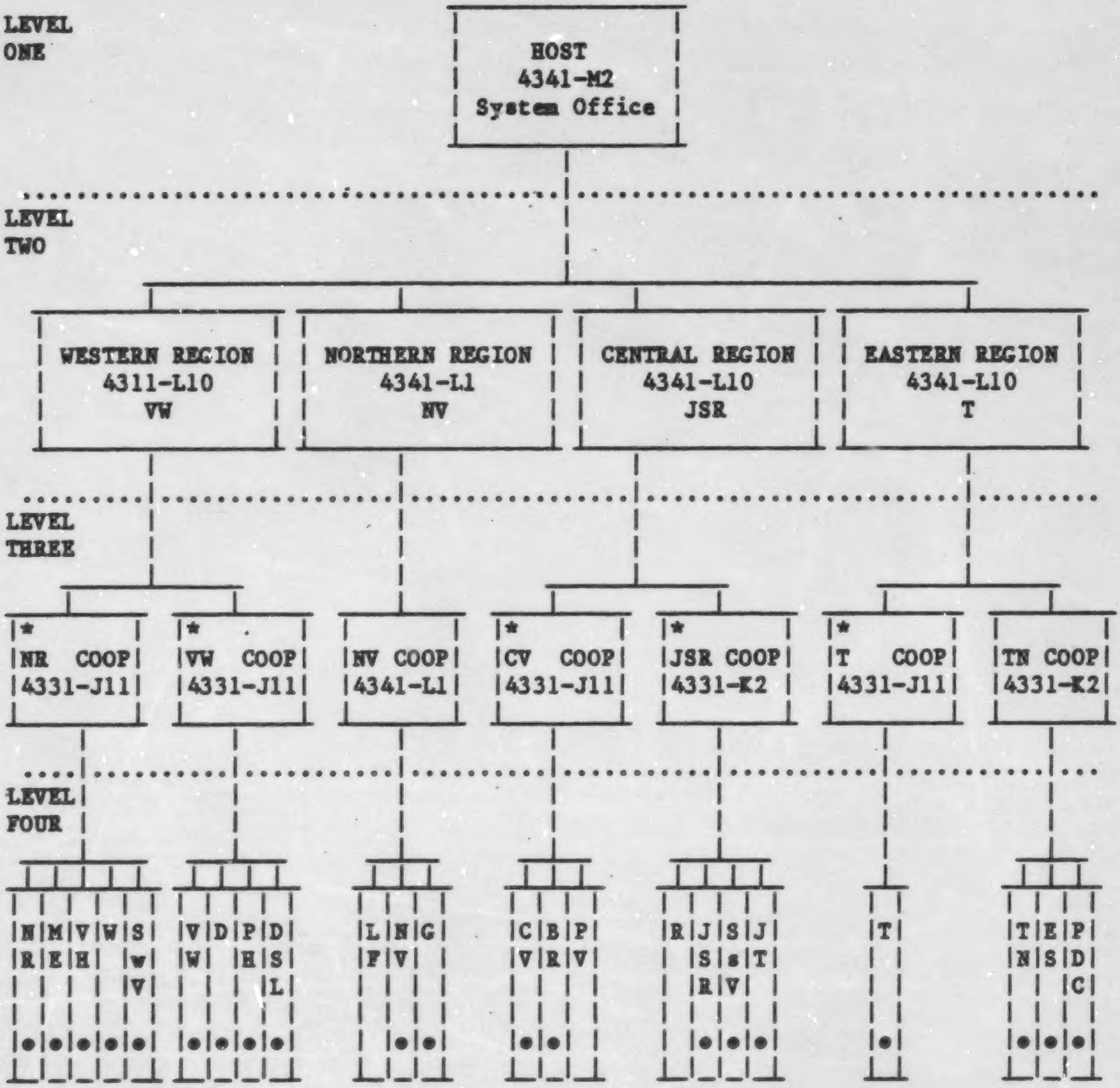
Facilities Utilization

Learning Resources
- Acquisitions
- Cataloging
- Circulation
- Serials Control

APPENDIX VI

CURRENT STATUS OF VCCN EQUIPMENT INSTALLATION

* To be installed
● Currently running MUSIC
for academic support


LEVEL ONE
HOST
4341-M2
System Office
LEVEL TWO
WESTERN REGION
4311-L10
VW
NORTHERN REGION
4341-L1
NV
CENTRAL REGION
4341-L10
JSR
EASTERN REGION
4341-L10
T
LEVEL THREE
*
NR COOP
4331-J11
*
VW COOP
4331-J11
NV COOP
4341-L1
*
CV COOP
4331-J11
*
JSR COOP
4331-K2
*
T COOP
4331-J11
TN COOP
4331-K2
LEVEL FOUR
NR ●
ME ●
VH ●
W ●
SwV ●
VW ●
D ●
PH ●
DSL ●
LF
NV ●
G ●
CV ●
BR ●
PV
R
JSR ●
SsV ●
JT ●
T ●
TN ●
ES ●
PDC ●

Note: It is important to emphasize that size and number of computing installations and their locations are subject to change in the final network configuration.

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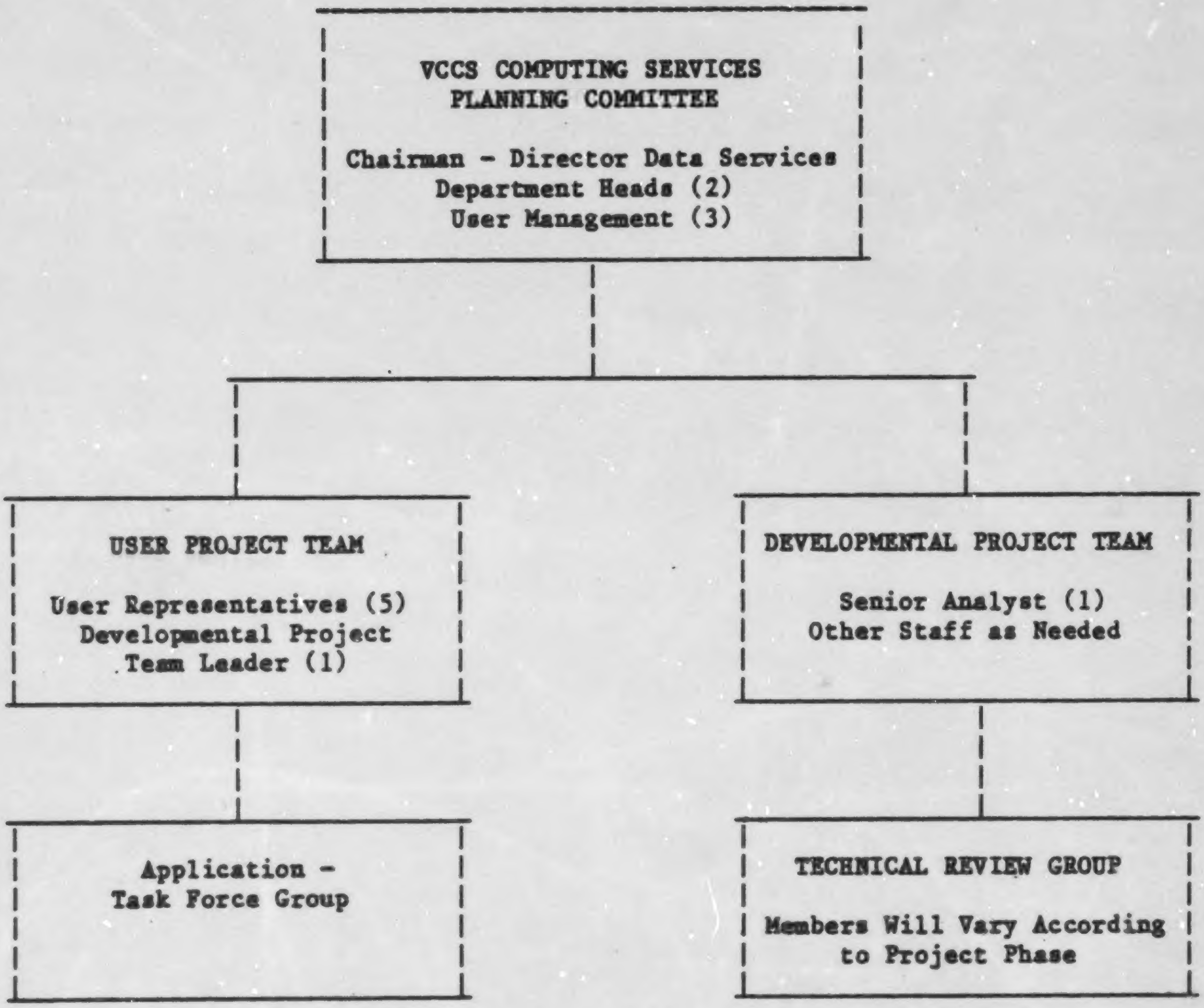
APPENDIX VII

VCCN SYSTEMS MANAGEMENT DESIGN


VCCS COMPUTING SERVICES PLANNING COMMITTEE
Chairman - Director Data Services
Department Heads (2)
User Management (3)
USER PROJECT TEAM
User Representatives (5)
Developmental Project Team Leader (1)
DEVELOPMENTAL PROJECT TEAM
Senior Analyst (1)
Other Staff as Needed
Application - Task Force Group
TECHNICAL REVIEW GROUP
Members Will Vary According to Project Phase

APPENDIX VIII

INSTITUTIONAL RESPONSES

A draft version of this report was sent in June, 1983, to all Virginia public institutions that have programs in the Computer Science discipline. The Task Force requested that the institutions correct any errors of fact in the draft, and solicited any comments that the institutions might care to make about the Task Force's findings, conclusions, and recommendations. These comments would be included in the published version of the report if the institutions so desired.

Following are the responses from the ten institutions that wished their comments to be included in the published report. Because numerous minor changes were made to the report after the draft version was distributed for comment, the page references in the institutional responses have been corrected to correspond to the final version.

The institutions that requested that their responses be included in this report are:

Christopher Newport College
George Mason University
Mary Washington College
Norfolk State University
Old Dominion University
Radford University
College of William and Mary
Tidewater Community College
Virginia Western Community College
Wytheville Community College

Christopher Newport College

50 Shoe Lane
Newport News, Virginia 23606

Institutional Commentary on "An Assessment of Computer Science Programs in Virginia"

August 1983

The College wishes to express its concern about the general tone of this report, with special reference to its evaluative remarks that are offered without clear definition and/or support.

It is understood that the drafting task force made use of the joint ACM-IEEE standards for computer science program requirements, but it is unclear as to whether Council is, by implication, sanctioning, endorsing, or adopting these standards. If such is the case, then there is a correlative obligation to develop state-wide strategies to provide the resources needed to meet such standards. Otherwise, meeting of such standards in one discipline (computer science) can only be accomplished at the expense of other equally important components of institutional curriculum and mission.

A number of statements made in the report, such as those relating to poor terminal access, limited professional development of the faculty, poor library resources, high teaching loads, low salaries, and little control of the quality of students admitted to the programs are, in the judgment of the College, conjectural and largely unsubstantiated. To the extent that such allegations contain any elements of truth, they can be properly understood only in the context of ongoing developments. For example, in 1982-1983, Christopher Newport College committed its largest increase in resources to the Department of Computer Science. It purchased a PRIME-750 Computer that is dedicated entirely to support of the instructional program and more than doubled the number of terminals accessible to students. With respect to faculty workloads, it is noted that computer science faculty have the same teaching loads as faculty in other departments and that they have above average salaries when compared to faculty in other disciplines.

In sum, the College is concerned that such self-serving and largely undocumented evaluative statements are not an accurate assessment of its computer science programs. Particular exception is taken to the recommendation that Christopher Newport College concentrate its efforts on either the computer science degree or the information science degree. The College sees no evidence in the data nor in the report that justifies such a statement. Each of these degrees serves the needs of different students, and each is a viable major in the College's curriculum. The recent shift in students from information science to computer science which was experienced with the initiation of the computer science major in the fall semester, 1982, should be viewed as a temporary adjustment. All indications are that the information science program will continue to serve a large number of the College's students--students who would not be well-served in its absence. A symmetrical statement can be made about the computer science program.

The above comments should not be interpreted beyond their stated scope; they are not, in particular, to be construed as constituting an overall negative reaction to the report on the part of Christopher Newport College. The College finds much of the report to be well done and helpful; it wishes only that it were characterized by a somewhat more balanced interpretation of data and by less speculative judgment and conjecture. The College will use this report as much as is possible and appropriate in the further evaluation of its degree programs in both computer and information science.

BEST COPY AVAILABLE

George Mason University
The State University in Northern Virginia
4400 University Drive • Fairfax, Virginia 22030

Office of the Vice President, Academic Affairs

July 13, 1983

Dr. John E. Molnar
Co-Chair, Task Force on Computer Science
Council of Higher Education
James Monroe Building
101 North Fourteenth Street
Richmond, Virginia 23219

Dear John:

George Mason appreciates the opportunity to review further the computer science task force report and this letter, together with attachments, constitutes our response. First, I would request that the letter that I previously sent to you regarding factual errors be included in the corrected and final copy, as I believe you have already done.

The review was coordinated by Averett Tombes, the Dean of the Graduate School, who consulted primarily with Richard Draper, Chair of the Department of Mathematical Sciences, wherein the programs in computer science are located; Fred H. Siff, former Chair of the Decision Sciences Faculty; and Terry Hardgrave the new Chair of that faculty. I have reviewed their recommendations, discussed them with Dean Averett Tombes, and have the following to report as the recommendations for George Mason University regarding the computer science task force report.

Computer Science Assessment

1. On page 13, table 2, the MS in Computer Science did not start in 1980. The correct date should be 1982.

2. On page 26, lines ~~13~~ 6 and ~~14~~ 7 read: "The computer science core--... does not include algorithms and ... an advanced level." In fact CS 483, Data Structures and Analysis of Algorithms, is a required course in the program. This course corresponds very closely to the course CS 7, Data Structures and Algorithm Analysis listed in curriculum '78 of the ACM. I regard the present statement in the report as factually incorrect. To be factually correct, the words "Algorithms and" should be deleted.

3. On page ~~27~~ 26, line ~~8~~ 23 reads: "The institution is considering how to limit computer science enrollment." The computer science as of fall of 1983 had effectively limited enrollment in computer science. While the administration has some problem in a department determining on its own recognizance

the grade requirements for a major without consultation, in this case the step was probably needed. At present the department does control admission to the core courses CS 111, CS 211, CS 212. A large number of students have been denied enrollment in the computer science program. A more appropriate and factual statement would probably be, "The institution has effectively limited enrollments in the computer science program to the most qualified students."

MIS Chapter

The comments from the Decision Sciences group are not as concise as those from computer science. They also include a series of suggested errors of fact together with some disagreements with interpretation. I will try to separate out to the best of my ability what I perceive as errors of fact and report these first and then follow up with what might be termed disagreements of interpretation. Most of the disagreement comes from some of the specific recommendations contained in the report. The following recommendations are questioned by Decision Sciences faculty:

1. "Offer at least one more course in the areas of organizational systems." Students now get a full set of business courses and may take further electives in accounting information systems, marketing information systems, and the like. The required capstone course of INFS 411 is directly relevant to this area as well.

2. "Offer a course in data structure analysis or file organizations." The course INFS 310, Program Structures and Design Using COBOL, is required of all students and INFS 311, Data Based Management, is required in two of the three tracks. These courses adequately cover these topics.

3. "Offer at least two courses in the area of development of information systems," We have two such courses --- INFS 403, Computer Systems Analysis and Design, and INFS 411, Management Information Systems (in the catalog description "integration of prior learning in computation in management information needs and different functional areas of administration. Students design and implement aspects of an MIS for an organization.").

4. "FORTRAN should be replaced with a course more oriented to information systems." FORTRAN is covered in one-half of an elective course (required in one of the three tracks). We have found that in the D.C. area some students are often considered more valuable in the marketplace with some FORTRAN provided as an option. Also, there are a number of large systems in FORTRAN (e.g., PRIME's, PRIMOS, and INTEL'S SYSTEMS 2000). It is too premature to drop FORTRAN altogether.

5. "Add at least three courses in computer and information technology and in the development of information systems." Simulation is given as an example--it is already in the curriculum, under the BUAD prefix taught by our faculty. Also, INFS 710, Computer Architecture and Operating Systems, as well as INFS 720, 722, and 723 are already required in the program.

In addition to the above suggested possible factual errors, I think there is an overall disagreement in interpretation both with respect to discussion of academic credentials and the nature of the form of the MIS and Information Systems program. With respect to academic credentials, they note that in your report it states "few faculty appear to have special talents or expertise in MIS" (Siff, Ruth, Hardgrave, and Cole are four of the seven graduate faculty), "many are recent" (Hardgrave, Gardner, and Cole are the only graduate faculty with less than three years at GMU--three of seven). Perhaps the phrase "many and few" ought to be reversed, if used at all. In any event, highly qualified recent hires are a real plus for any computer program these days because it demonstrates ability to hire faculty, continued growth of programs and new research directions. In our case the recent faculty come from pseudo-academic environments with strong, nationally recognized research capabilities.

The point of interpretation is also made that the MS in Information Systems at George Mason University really is in the mold of the Boston University program as noted earlier in the chapter of the report. Without going into the details of this argument, I suggest that you check the form of our MS in Information Systems and compare it to the Boston University program.

There is also a request from the School of Business Administration that the task force report take into account the restrictions placed upon the School of Business Administration in our attempt (currently in its second stage of development) to obtain accreditation from the American Assembly of Collegiate Schools of Business. There are certain curricular requirements that we must follow in order to obtain accreditation.

Thank you again for the additional opportunity to comment on the task force report.

Sincerely,

David J. King
Vice President
Academic Affairs

DJK:a

MARY WASHINGTON COLLEGE
EDERICKSBURG, VIRGINIA 22401
Office of the Vice President for Academic Affairs and Dean 703 899-465

August 29, 1983

Dr. W. G. Thrombley
State Council of Higher Education
101 N. Fourteenth Street
Richmond, Virginia 23219

Dear Dr. Thrombley:

While the statistical information about Mary Washington College's Computer Science program was correct as of October 1982, we would like to note the following additions and improvements that have been made since that date.

An additional full-time position in Computer Science has been added.

The PRIME 550-II computer with 1.5 megabytes of memory was traded-in and replaced with a PRIME 750 computer with 2 megabytes of memory. An additional 16 ports are available on the new system.

Additions to other existing equipment include:

4 ADM 5 terminals
1 300 line per minute matrix printer
1 DMP-29 Plotter

In newly-renovated Chandler Hall we have the following computer equipment:

1 PRIME 2250 computer with 1 megabyte of memory, a 58 megabyte disk drive, a cartridge tape system and 8 user ports
1 PRIME 2250 as above with a total of 24 user ports
8 ADM 22 terminals
8 PRIME PST 100 terminals
1 DIABLO 630 KSR terminal/printer
1 NEC Spinwriter printer
2 Okidata printers

MUSE word processing software
INFO relational data base software

Also PRIMENET software and appropriate hardware is being installed to implement a local area network on campus consisting of the PRIME 750 and the two PRIME 2250 computers above.

Thank you for this opportunity to update the information concerning the Computer Science program at Mary Washington College.

Sincerely,

Mary Ann T. Burns
Vice President for
Academic Affairs and Dean

MATB:vmj

NORFOLK STATE UNIVERSITY'S REACTION

TO THE

REPORT OF THE TASK FORCE ON COMPUTER SCIENCE

We have reviewed the final report of the Task Force on Computer Science and, again, we are extremely dissatisfied with the evaluation of the Computer Science Program at Norfolk State University. While we recognize that we have areas requiring improvement, it is disturbing that virtually no aspect of our program elicited a positive assessment from the Task Force. Moreover, it appears that, in some instances a deliberate attempt was made to avoid a discussion of any area where positive remarks could have been cited. We take this position with respect to the general areas (curriculum, mathematics requirements, faculty, students, and program organization) considered in the overall assessment, and also because the Task Force failed to conduct an appropriate site visit. Such a visit certainly would have provided a greater insight into a program that is in its embryonic state.

In an effort to provide you with specific reactions to the Task Force Report, we cite the following:

Curriculum

> "The advanced electives were not specified in the institutional self-study and thus were impossible to assess."

> The institutional self-study report guidelines did not require a specific delineation of advanced elective courses. However, our self-study report does include the general categories of advanced electives that our students complete at Old Dominion University. Further, Since the Task Force had no difficulty requesting additional information regarding other aspects of our self-study, we really question the motivation of this statement. For the record, our students select 18 hours of advanced electives (6 hours may include upper level mathematics courses) from the courses listed below:

BEST COPY AVAILABLE

COMPUTER SCIENCE ELECTIVES

Operating Systems
Compiler Construction
Artificial Intelligence
Microcomputers
Discrete Structures
Data Base Concepts
Minicomputer Systems
Computer Graphics
Data Communication Systems
System Program Design
Computer Systems
Microprocessors & Microcomputers

"Only one year of science is required."

The 1978 ACM Model Curriculum does not specify an exact number of laboratory science credit hours for computer science majors. Nonetheless, Norfolk State students can elect to complete additional science courses as they fashion areas of specialization through the appropriate selection of advanced electives.

Mathematics Requirements

Supportive mathematics requirements were not addressed in the assessment of our program. Certainly, a positive statement is in order here, as our 24-hour mathematics component is in complete accord with Curriculum '78 recommendaations, as well as the guidelines in the ACM IEEE/CS Position Paper.

Faculty

"The number of faculty available to offer the program is good, but their backgrounds in computer science are still weak."

This assessment is unacceptable. Presently, none of our computer science faculty members have terminal degrees in computer science. However, we deny vehemently that their backgrounds are poor. Our faculty members have formal academic training in such areas as programming languages, database systems, computer science theory, and computer organization and architecture. Moreover, they bring a much broader range of experiences as a result of their research efforts with government and industry. One faculty member has been involved in such endeavors since 1968. A pioneer in computer activities at Norfolk State, he has worked with such companies as IBM, Mitre Corporation, Western Electric, Jones-Laughlin Steel and U.S. Department of Commerce. Another faculty member has had several research contracts with NASA, Langley Research Center focusing on Artificial Intelligence and

Computer Algebra Systems. A third member has worked as a programmer/analyst, a research and teaching assistant in a computer science doctoral program and has engaged in research in Computer Graphics and Simulation at NASA. Leadership in a curriculum development provided invaluable computer experiences for a fourth faculty member. An instructor who has a masters degree in computer science is earning credits towards a doctoral degree in computer science. In fact, all faculty members have made plans for additional professional growth and development consonant with plans for the future growth and development of our computer science program.

Two other factors should be considered in assessing the quality of the faculty: one is that the Commonwealth is providing enhancement funds to increase the number of faculty members in computer science. Secondly, Norfolk State students have the opportunity to take advantage of resources that are available at Old Dominion University. Such resources include faculty expertise in computer service. (Please see the attached Old Dominion University letter).

Students

"Based on self-study data about SAT scores, the quality of students appears to be quite low."

Our first response to the statement is that SAT scores are not always valid predictors of academic success. Secondly, Norfolk State University is an open admissions university and as such, admits students of varying backgrounds and levels of academic preparedness. However, we have established strong student programs which are designed to overcome the marginal preparations of some segments of the student population.

As noted in the NSU Self-Study section regarding admissions criteria, demonstration of "minimal proficiency in the equivalent of college algebra is a prerequisite for enrolling in the computer science courses required by the program." A well established mathematics program featuring a Mathematics Reinforcement Center and a Computer-Based Academic Development System (C-BADS) provides the University with an effective program that enables students to develop the minimum competencies alluded to.

The "readiness" levels of students is ascertained by placement examinations. Such examinations comprise the focal point of the University's remedial and general education programs.

Finally, an indicator of the quality of our students is that over the last five years 62% of the students completing our computer science emphasis program graduated with honors. Moreover, they have received outstanding offers from industries and graduate schools.

Organization

"There is a clearly defined coordinator for computer science, but the program may still suffer from being combined with mathematics."

The computer science program coordinator at Norfolk State is released from academic duties at the same rate as department chairpersons. This individual is responsible for all administrative functions of the program, including the management of a separate computer science budget. Therefore, we fail to see how the program may suffer by simply being housed within the Mathematics Department. The statement is even more puzzling in view of the fact that the appointment of a separate computer science coordinator within the Physics and Mathematics Department at Mary Washington College "was a wise decision."

The above statements are representative of our major concerns regarding the report of the Computer Science Task Force. In the event that additional information is needed, we will be happy to appear at one of the Task Force meetings or serve as hosts for a site visit.

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OLD DOMINION
UNIVERSITY

School of Sciences and Health Professions
Office of the Dean • (804) 440-3274 – Norfolk, VA 23508

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SCHOOL OF HEALTH RELATED
PROFESSIONS AND SCIENCES
NORFOLK STATE UNIVERSITY

October 23, 1980

Dr. Donald Taylor, Dean
Health Related Professions and
Natural Sciences
Norfolk State University
Norfolk, VA 23504

Dear Don:

The past two decades have spawned a proliferation of professions that require knowledge of and facility with computers. In addition, newer technology and wider usage of computers have become a staple in every facet of education. In order to close the gap between the demand for graduates in computer science and the current production I feel that a more concerted effort must be made on the part of academic institutions to develop and implement computer science programs to fill the gap between supply and demand. Manpower studies indicate that the demand for B.S. computer science graduates in Virginia in 1980 is 1700 per year while only 280 per year are being produced. Nationally the demand:supply ratio is 5:1.

In light of this level of demand and given the potential of a program at NSU, the best that could be achieved would be to just scratch the surface of present and future need.

Based on our previous and ongoing discussions concerning your proposed program leading to a B.S. degree in computer science, I am pleased to endorse the revised computer science program that you have shared with us. The School of Sciences and Healt Professions supports your program and applauds your spirit of cooperation with this venture.

ODU will assist NSU in the implementation of its B.S. program in Computer Science with the following:

1. Facilities and Equipment - ODU will provide NSU students with access to those computer science courses which utilize specialized computer equipment. In addition, our library holdings in computer

science are available to NSU faculty and students. This assistance will negate duplication of large expenditures for specialized hardware by NSU.

2. Instruction - ODU encourages NSU students to enroll in computer science courses as part of their regular or elective program. These courses would include: Operating Systems, Modeling and Simulation, Compiler Theory, Artificial Intelligence, Micro-Processors, Systems Programming, Computer Graphics, etc.

3. Research/State of the Art Conferences and Seminars - ODU will provide ongoing opportunity for NSU faculty research and development through jointly sponsored seminars and/or conferences.

As we are both very pleased with the relationship that exist between ODU's School of Sciences and Health Professions and N School of Health Related Professions and Natural Sciences, OD will also welcome the minority graduates from NSU's program i its new masters program in computer science.

I am hopeful that State Council will see fit to add a second needed B.S. program in Computer Science to the Tidewater area

Sincerely,

Tom

Thomas P. Wallace, Dean
School of Sciences and
Health Professions

/cbc

cc: Dr. Bieber
Dr. Rittenmeyer

Comments from
Old Dominion University
on the
Computer Science Task Force Report

Old Dominion University looks with favor upon the concept instigated by the State Council of Higher Education of evaluating programs offered by Virginia's state-supported institutions of higher education. Such evaluations serve the purpose of identifying strengths and weaknesses of existing programs, and pave the way for program improvement both by the institutions and, where necessary, by the Commonwealth. Administrators and faculty of the University are also appreciative of the professional manner in which the Task Force on Computer Science approached its task, and of its assiduous attention to details that might otherwise have been overlooked by a less conscientious group. The inclusion on the Task Force of one of ODU's computer experts, Dr. Richard T. Cheng, is especially appreciated, for this appointment not only gave tacit recognition to the quality of the University's computer science program, but gave further credence to the Council's assertion that Virginia's institutions are the primary guarantors of the quality of their activities.

We offer the following additional comments for the Council's consideration. While we understand that our disagreements with the Task Force may stem from differences in interpretations, semantics, or both, we strongly believe that in fairness to the University and its computer science program, the suggested changes deserve the Council's serious attention.

1. Good evaluation practices require at the outset that standards of quality be established against which program characteristics are to be measured. In the absence of such standards, evaluative judgments are likely to be subjective, and evaluatees are left without a clear sense of direction for program improvement.

   To some extent, this situation has prevailed in the Task Force's study of Old Dominion University's computer science program. Terms such as "weak", "sound", and "strong" are used to characterize program faculty, curriculum, and facilities without reference to specific data or standards against which these judgments were formed. ODU program officials would be aided by more definitive statements as to what constitutes a "sound" program, a "strong" faculty, and an "excellent" curriculum. The University would be helped also be the establishment of specific guidelines or models for computer science programs in the State, and a standardizing of minimal competency requirements for computer science degrees.

2. The Task Force made specific reference to the insufficiency of available research-oriented faculty for the emerging doctoral program in computer science, although it (the Task Force) acknowledged that ODU's related doctoral program is new. As a point of fact, ODU's Ph.D. program was in its first year of operation at the time of the Task Force's study and the master's program was only in its second year. Since ideas and inspiration for research are often generated by deep involvement in program activities, it seems reasonable to expect that faculty of a new program will have had limited research opportunities. ODU is confident that research productivity of its computer science faculty will improve as the doctoral and master's programs become better established. The University asks that the revised report reflect more vividly the developmental status of ODU's graduate computer science programs, and that the relationship of faculty research productivity to the programs' infancy be acknowledged.

3. Tables 4 and 6 of the Task Force's Report reflect inaccurate data for Old Dominion University.

Table 4 shows for ODU a headoount of 315 full-time undergraduate majors in computer science. The correct figure is 665. As the Report indicates, criteria for declaring undergraduate majors vary from institution to institution. At Old Dominion University, undergraduates may pursue coursework required of a chosen major, by may not formally declare the major before completing general University requirements including English 110. Three hundred and fifty (350) students have informally declared computer science as a major as evidenced by their verbal commitments, but, more important, as indicated by their persistence in taking courses leading to the completion of computer science degree requirements. These 350 students, we submit, should be added to the 315 full-time undergraduates recorded in Table 4 for Old Dominion University.

Table 6 shows for ODU's computer science program three full professors, with only two having the terminal degree in computer science or a closely related field. Apparently, Electrical Engineering was discounted as a field closely related to computer science. Since the required background and training for electrical engineering and computer science are very similar, (indeed the computer science program at the University of Pennsylvania, MIT, and the University of California at Berkeley—three of the oldest and most prestigious programs in the nation—are housed within the Department of Electrical Engineering) we suggest that the fields are closely related and that the number of professors (Table 6) be corrected to show 3 (3) for Old Dominion University.

As stated at the outset, we understand that these and other differences between ODU and the Task Force may be a matter of interpretation. However, we are adamant in the position that our appointments of faculty to computer science and other programs are based upon the conviction that appointees are well-grounded in the fields to which they are assigned.

Any indication that a full professor is appointed to a field unrelated to his/her terminal degree is a negative reflection on our administrative judgment and a grave misrepresentation of the facts. We therefore urge the Council to effect the suggested change.

4. Finally, the Task Force's statement (paragraph 4, sentence 2, July 1983 Confidential Draft) that "There does not ... appear to be any significant articulation between the baccalaureate programs and the business processing programs in the two-year colleges" is inaccurate as it relates to Old Dominion University. There is a clear articulation between ODU's Management Information System (MIS/DS) Department and the Virginia Community College System. This relationship is explained in the ODU Community College Transfer Guide. Although the MIS/DS Department normally does not accept 200 level community college courses to meet upper level MIS requirements, the Transfer Guide describes how each community college course may be transferred to ODU.

   Old Dominion University requests a revision of the above referenced statement to reflect ODU's articulation arrangements with the Virginia Community College System.

Radford University
Radford, Virginia 24142
(703) 731-5404
Office of the Vice President
for Academic Affairs

August 25, 1983

Dr. Woodworth G. Thrombley
State Council of Higher Education
James Monroe Building
101 North Fourteenth Street
Richmond, Virginia 23219

Dear Dr. Thrombley:

I appreciate the time and effort the Task Force on Computer Science has put into the preparation of its final report. The report contains some recommendations that will certainly warrant further consideration. It is helpful to have the Task Force call to the attention of state officials some of the problems facing higher education in the area of computer science programs. The pressing problems of too few available faculty and limited resources for essential equipment affect us all and must be dealt with promptly at the state level.

Although the report of the Task Force contains some good advice, it still contains many serious distortions of the existing program at Radford. I continue to be disappointed in the failure of the Task Force to provide any constructive criticism of the programs reviewed. Despite our repeated efforts to obtain from the Task Force any evidence to support its comments regarding Radford's program, no such evidence has ever been provided. The report remains essentially a compendium of unsubstantiated opinions that, in my judgment, will do little to improve the quality of the programs being evaluated.

I shall addresss the Task Force's report in three primary areas as follows:

A. Faculty

B. Facilities

C. Curriculum

A. Faculty

While we strongly disagree that faculty expertise in our computer science program is "weak", this is clearly a judgment call of the Task Force and it is not likely that our attempts to reiterate again the credentials of our faculty will change this opinion. I would like to emphasize, however, that our computer science faculty all possess credentials which exceed those recognized by the Task Force as being acceptable for baccalaurate level instruction.

Radford University, like other institutions, would like to hire more computer scientists. However, we are not oblivious to the realities of the hiring situation. Our search continues, but we have been able to meet adequately our requirements with the staff we have. The three computer scientists on our staff can teach seven computer science classes per quarter, more than enough to meet the immediate needs of our program. None of our computer science faculty have left Radford, and we have hired two additional computer scientists for the next academic year.

Our faculty are not weak nor are they inadequately prepared. We are not attempting to operate both undergraduate and graduate programs with the faculty we have. What we do is conduct a baccalaureate level computer science program with faculty who have been well trained in the appropriate disciplines. We teach computer science classes with computer scientists, mathematics classes with mathematicians, and statistics classes with statisticians.

I should also point out that Table 6 of the Task Force Report is misleading and depicts the faculty situation at Radford in a most negative fashion. To list all of Radford's faculty in the "Adjunct or Part-time" category leads the reader to believe that the computer science program is run by faculty who work on a part-time or adjunct basis. In reality, all eight faculty who work in our program are full-time faculty who, for very good reasons, happen also to do something else in addition to teaching computer science courses.

For consistency, our faculty must be counted the same way faculty at other institutions are counted. Radford's line in Table 6 should be:

Prof.	Assoc. Prof.	Asst. Prof.	Inst.	Total	Number Tenured	Adjunct or Part-Time
2(1)	3(2)	2(1)	0	7	4	1

B. Facilities

The Task Force Report on Radford's program includes a comment that "few support services are available." I have addressed this point before, but will do so again.

Our computing resources are not ideal. We acknowledge that fact. We have known of our shortcomings and have been taking steps to solve the problems. The administration is committed to full support of the computer science program. This committment extends to all aspects of the program, including equipment.

Prior to October, 1982, Radford University relied on a communications link to Virginia Tech for computing support. At that time, we installed a new computer on campus and assigned to the academic program a Hewlett-Packard 3000 Series III. All computing has since been done locally. This computer is dedicated to academic computing with 35 terminals available for students. Faculty teaching in the program have 24 hour accessibility to eight terminals. In addition, if at any time a faculty member is unable to use one of the eight terminals, additional terminals in the administrative computing area are made available.

We acknowledge the fact that a HP 3000 Series III is not "state-of-the-art." It would have been relatively simple to install a new computing system in 1982. However, we decided one year ago to test the system carefully, evaluate our needs on the basis of real experience, and then purchase a new computer. To that end, a REQUEST FOR PROPOSAL for a new academic computing system was prepared while keeping in mind the experience we had gained over the preceeding months. The RFP was issued on July 1, 1983 with installation expected in early winter. So, if there is a real, or perceived, weakness in computing equipment it has been addressed and is being corrected with full administration support. This "on-going" process in equipment evaluation and selection has enabled Radford University to make judicious, wise choices.

In October 1982 the Computing Center was relocated to a larger, refurbished facility. This area includes all of the academic computing equipment except for terminals and printers located in faculty offices and academic departments. It is an attractive, accessible facility and will become even better next winter when a new academic computer is installed.

C. Curriculum

In the early planning stages of our computer science curriculum we determined that we would conform to certain well-established criteria for such a program. Our guide was "CURRICULUM '78."[1]. We have adhered very closely to the recommendations of that document.

Our self-study contained a complete list of course syllabi for all of our computer science courses that were on the books in the fall of 1982. To make it clear to the Task Force that all core requirements were covered in our program, the courses and core items were illustrated in a carefully prepared table that indicated clearly that our computer science program was developed following the "CURRICULUM '78" guidelines. Our CPSC 110-111-112 sequence provides a solid foundation of the ACM core material and allows for coverage at a more theoretical and conceptual level in the upper division.

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[1] Austing, R., Barnes, D.I., Bonnette, D.T., Engel, G.L., and Stokes (Editors), "CURRICULUM '78: Recommendations for the Undergraduate Program in Computer Science," Communications of the ACM 22, 3 (March 1979), p. 147-166.

As you are aware, CURRICULUM '78 proposes two Computer Programming courses in a computer science program and recommends that a "programming language that is widely used" be taught. In our CPSC 110-111-112, we teach PASCAL a language of choice among computer scientists. The reading list for these courses provided to the Task Force clearly indicates that the programming portion of the course is well below 50%. This can hardly be construed as having "too heavy an emphasis on elementary programming" when considered in light of the recommendations of CURRICULUM '78. As additional documentation, I call your attention to the course syllabus for this particular sequence provided to the Task Force in the Self-Study (pp. 25-26). This syllabus clearly follows the recommendation of CURRICULUM '78. On what basis does the Task Force make the statement that "there is too heavy an emphasis on elementary programming and introductory concepts?" We agree with the authors of CURRICULUM '78 that "the elementary core material represents subject matter necessary for all students in computer science in order to be able to achieve the objectives of the undergraduate major." Our sequence, CPSC 110-111-112, is, as stated in the Self-Study, "required as a prerequisite for advanced courses in the field." It is a prerequisite for every upper division course in the computer science curriculum. We are fully cognizant of the needs of beginning computer science students. We designed our curriculum with well-established guidelines in mind. It is, in fact, very clear that we adhere closely to the recommendations of CURRICULUM '78. If we place "too heavy an emphasis on introductory concepts," then I suggest that perhaps we need to reevaluate CURRICULUM '78. It is certainly a well established practice to introduce majors to their discipline in a course along the lines of our CPSC 110-111-112. The elementary material is essential, and the ACM, as articulated in CURRICULUM '78, agrees.

As I stated in my May 17, 1983 letter, FORTRAN and COBOL have been dropped as degree requirements in computer science. In their place, we have six, one-credit self-paced programming courses (PASCAL, FORTRAN, COBOL, BASIC, LISP, and SPL). These are not required, but it is expected that the typical computer science major will want to take advantage of the opportunity to learn new languages. This is part of our continuing efforts to make appropriate changes to our curriculum in light of the consideration that computer science is a dynamic and rapidly changing discipline.

The design of some of the courses in our curriculum does not adhere strictly to that suggested in CURRICULUM '78; however, the topics covered are the same. CURRICULUM '78 recommends the following topics in CS 6 (Operating Systems and Computer Architecture).

A.	Review. Instruction sets. I/O and interrupt structure. Addressing schemes. Microprogramming.	(10%)
B.	Dynamic Procedure Activation. Procedure activation . . .	(15%)
C.	System Structure. Design methodologies . . .	(10%)
D.	Evaluation. Elementary queueing, . . .	(15%)
E.	Memory Management.	(20%)
F.	Process Management.	(20%)
G.	Recovery Procedures.	(5%)
H.	Examinations.	(5%)

A cursory review of Radford's Self-Study shows the following:

A. Covered in CPSC 350, 450, 470. Also covered at a more elementary level in CPSC 111 and 112.
B. Covered in 471.
C. Covered in 470
D. Covered in CPSC 450 and 470.
E. Covered in CPSC 470.
F. Covered in 470.
G. Covered in 470.

The detailed descriptions are available in the Self-Study provided to the Task Force. Again, it is clear that we have adhered closely to the guidelines of CURRICULUM '78 and we cover the appropriate material. It is inconceivable to me that the Task Force after reviewing the content of Radford's curriculum, could conclude that coverage of operating systems is "inadequate." The material recommended by the ACM is covered, and it is taught by qualified faculty. There is no basis in fact for the judgment of the Task Force.

The detailed descriptions of our CPSC 350 and CPSC 450 were also provided in the Self-Study. I submit that all of the topics recommended for CS 6 in CURRICULUM '78 which relate to computer architecture are covered in one or the other of these two courses. On what possible grounds does the Task Force base its statement that "coverage of computer architecture is inadequate?"

The two courses cover the proper selection of material and they are taught by qualified computer scientists. I respectfully submit that the judgment of the Task Force in regard to the adequacy of coverage of these two topics is in error and may be based on a lack of understanding of course content.

Radford University chooses not to expose students to the analysis of algorithms in an abstract environment taken out of context, but rather to cultivate in students good design skills and a good understanding of the performance characteristics (space/time complexity) of various algorithms in the setting in which the algorithms are studied. The concept of "algorithms" pervades our entire curriculum. It is an essential part of our courses CPSC 110, 111, 112, 330 and 460. These courses are taught by qualified faculty and the coverage certainly is not "inadequate." The Task Force's judgment that "coverage of algorithms is inadequate" is totally unsubstantiated and the statement should not have been included in the report.

All of us in higher education are aware of the declining mathematical abilities of college graduates. This is a national problem, not one localized to Virginia. The Task Force recognized that a "high-quality undergraduate program includes concentrated studies of mathematics and its application to computing, algorithms, . . ."

The ACM recognizes the importance of mathematics in a computer science curriculum. CURRICULUM '78 proposed CS 13: Algorithms, with one topic, "Numerical Analysis," to account for 10-25% of the material. The same document proposed a separate course, CS 17: Numerical Analysis. The following is the detailed description of our course, CPSC 330: Numerical Analysis:

> "A study of algorithms that are useful in connection with obtaining numerical solutions of problems using a desk calculator or digital computer. Topics include the solution of linear and nonlinear systems of equations by iterative methods, interpolation, finite difference calculus, least squares analysis, numerical differentiation, numerical integration, solution of systems of linear equations by Gaussian elimination, evaluation of determinants, matrix inversion and the solution of differential equations. Error analysis for the various algorithms is discussed.

The Task Force states that numerical analysis is "a questionable core requirement." I submit that it is anything but "questionable." It is a step toward improving the mathematical abilities of college graduates and can only enhance the quality of a computer scientist. The value of numerical analysis is recognized by the ACM in CURRICULUM '78 and it is difficult to understand how the Task Force can question the appropriateness of the course in a computer science curriculum.

Radford's Self-Study clearly shows that STAT 441:442, Operations Research, is an advanced elective in the computer science program. Some schools call Operations Research a computer science course. We considered that option, but decided to continue to use the statistics title for the courses. In any case, if Operations Research is acceptable as "an advanced level elective" at one school, then it should be considered "an advanced level elective" at Radford University.

In my May 17, 1983 letter to Dr. Molnar and the Task Force, I indicated that three additional senior level computer science electives had been approved and are now on the books. Therefore, our advanced electives available to computer science majors are:

CPSC 410, Modeling and Simulation
CPSC 420, Computability Theory and Formal Languages
CPSC 430, Computer Graphics
CPSC 440, Database Systems
STAT 441:442, Operations Research
STAT 410:411, Statistical Methods

It is obvious that we have significantly more than "only one advanced level computer science elective." While I can appreciate the Task Force's reluctance to recognize curricular changes that have taken place since the Self-Study was prepared, these changes were predicted in the Self-Study and failure to acknowledge them distorts our program's strengths.

The Department of Mathematics/Statistics and Computer Science at Radford University recently added a prerequisite to its introductory course, CPSC 110. This is the first required course for computer science majors. It now has the prerequisite "A grade of C or better in Calculus 161." This requirement alone will provide a screening procedure in the program. It has been our experience that many computer science students who wash out do so in a calculus course. Hence, our screening procedure for prospective computer science majors requires performance on the part of the student. This then, is the department's de facto standard for admission into the program.

I want to thank you for the opportunity to respond to the Task Force's comments regarding its review of Radford's Computer Science program. Please see that a copy of this letter accompanies the Task Force Report since I believe this letter will provide the reader with far more pertinent information regarding Radford's program than is available in the Task Force Report.

Sincerely,

David J. Moore

David J. Moore
Vice President for
Academic Affairs

www

THE COLLEGE OF WILLIAM AND MARY
OFFICE OF THE PROVOST AND VICE PRESIDENT
FOR ACADEMIC AFFAIRS

WILLIAMSBURG, VIRGINIA 23185

August 30, 1983

John E. Molnar, Co-Chair
Task Force on Computer Science
Council of Higher Education
James Monroe Building
101 North Fourteenth Street
Richmond, Virginia 23219

Dear John:

As I said to you on the telephone today, we would like to have our comments to the draft of the report of the Task Force on Computer Science appended to the final report. As George Healy wrote to you on May 23, Dean Rolf G. Winter and Professors George Rublein and W. Robert Collins looked at the draft when we first received it and have provided comments, which we have summarized as follows:

A. Some minor corrections and additions.

1. There is an undergraduate course, CS 444, Operating Systems. This course shares it status as an advanced elective with courses in compiler construction and data base management.

2. While the NASA holdings, especially in applied mathematics and numerical analysis, are quite strong, we believe that the College's subscription list in CS is more than sufficient to support any contemplated research program.

3. Microcomputer access is arguably not a crucial item in the undergraduate or graduate program. Interaction facilities for communication with the three mainframes are very good. However, a 12 station microcomputer laboratory is expected to be available by September.

B. Areas of general agreement.

1. We agree that the list of advanced undergraduate courses needs enhancement. Recent (c. April '83) meetings within the department have developed plans for additional undergraduate courses in architecture and artificial intelligence.

2. The master's program has problems typical of terminal M.S. programs. We believe that such terminal M.S. programs currently attract mainly people without undergraduate degrees in computer

science. Typically these students take all the advanced undergraduate courses and add some purely graduate courses. All of these students have good access to the job market.

3. We agree that the faculty is presently undersized. We are presently recruiting for three research oriented faculty in CS. So far, we have filled one position and are moderately optimistic about the other two. In any event, the advice offered by the Task Force about not beginning the Ph.D. program with a skeleton staff is well taken. Addition of four more staff (including the three above) is an absolute minimum before the Ph.D. program can begin. A fifth will be needed almost immediately thereafter.

We would like to note in this connection that while two of the current faculty have degrees in CS, a third member of the department (Professor Collins, Ph.D., mathematics) has a research record indistinguishable from holders of a CS Ph.D. His work this year includes an article published in a recognized CS journal and two lengthy, refereed articles accepted for CS conferences.

We believe that the contributions that can be made by adjunct faculty are treated too casually. The government and industrial organizations in our neighborhood include many people who would like to have closer contact with advanced education, and who will provide a unique resource for us.

C. One serious disagreement.

We strongly disagree with the point that the relationship between mathematics and CS is one which "inhibits" development of the latter at the College. CS has deep and permanent roots in two outside disciplines:. Mathematics and Electrical Engineering. They cite automata theory, algebraic coding theory; and combinatorial analysis of algorithms as three obvious examples of mathematics which can be called CS or CS which can be called mathematics. Moreover, one of the mathematicians on our staff has a research interest in analysis of algorithms.

Besides the contributions of our mathematicians to our CS program, several of the mathematics staff have carried their software expertise well beyond the elementary level. Outside support has been attained for a "sub-Ada" parser and an elaboration of the Sheffield Pascal compiler. Supported work will begin this summer on the implementation of a 68000 based driver for a robot arm. All of this work was or is being done by mathematicians. This

> work is not seen as part of an ongoing high level research project, but rather we think that it demonstrates a solid and healthy interaction between those who might be viewed too narrowly as strictly mathematicians or computer scientists in regard to mathematics vis-a-vis CS.
>
> A further example of this interaction is that our mathematicians with a strong interest in CS are making a major contribution to the program by teaching elementary and some intermediate CS courses. The reductions in pressure on the computer scientists permit them to do much more in the program than they could do otherwise.

In regard to the placement of the graduate program under Applied Science, there is some danger of confusion in the use of this rubric. For example, in order to assess our level of instruction in computer science accurately, it is necessary to examine the credit hours reported to SCHEV under both the Computer Science and the Applied Science HEGIS codes, which may not be the case for other institutions. The use of the Applied Science title, however, does permit some useful interdisciplinary arrangements. We will discuss the present structure thoroughly after the computer scientists we are presently recruiting have joined the department.

If you have further questions, please do not hesitate to let me know.

Sincerely,

Linda Collins Reilly
Associate Provost

cc: George R. Healy
Rolf G. Winter
George Rublein
W. Robert Collins

TIDEWATER COMMUNITY COLLEGE
STATE ROUTE 135
(804) 484-2121

DISTRICT OFFICE
PORTSMOUTH, VIRGINIA
23703

August 24, 1983

Dr. John E. Molnar, Co-Chairman
Task Force on Computer Science
State Council of Higher Education
for Virginia
James Monroe Building
101 N. Fourteenth Street
Richmond, Virginia 23219

Dear Dr. Molnar:

Tidewater Community College appreciates having had the opportunity to review the final report and recommendations of "An Assessment of Computer Science Degree Programs in Virginia." Copies were distributed to appropriate division chairmen and faculty members for review and the following represents Tidewater Community College's response to the report.

1. While there is not total agreement with the major recommendations which are listed in the Executive Summary, it is understood that they represent the judgment of the Task Force and, thus, are not subject to correction. Exception is taken, however, with the fourth recommendation which pertains to the retraining of faculty from other disciplines. That recommendation appears to be contrary to other portions of the study which express considerable concern with what the Task Force perceives as poorly-trained faculty. Retraining faculty from other disciplines to achieve a minimum equivalent of a baccalaureate degree in the computing discipline hardly seems to be a step toward increasing faculty qualifications. The efforts to retrain such faculty would necessitate a lengthy, expensive effort and would probably not provide better-qualified faculty than those which can be hired at the present time. Contracting persons with that level of training is not a problem.

2. Average enrollments of 24 to 27 students per class section are not considered to be excessive. Such enrollments are not unusual and are comparable to those of other courses taught within business divisions at Tidewater Community College. Through the utilization of open labs, class sizes do not adversely affect instructional quality.

CHESAPEAKE **NORFOLK** **PORTSMOUTH** **VIRGINIA BEACH**

3. The statistics involved in Table 19, page ~~70~~ 69, are questionable. A table comparing Fall 1982 headcount enrollments and majors with Spring 1982 graduates serves no useful purpose.

4. Statements dealing with articulation (pages ~~71~~ 70 and ~~72~~ 71, and elsewhere) contain indications that the purpose of an Associate in Applied Science degree program is not fully understood by the Task Force. Such programs are not designed for transfer to a four-year institution, nor as a path to a baccalaureate or advanced degree.

5. References on page ~~72~~ 71 to "ill-prepared students" and other conclusions about "remedial" data processing students are very subjective and have a questionable place within the report.

6. The fifth recommendation which appears on page ~~73~~ 72, "Data processing faculty consider raising the minimum grade necessary to continue into the next data processing course to 'C'" is very questionable. It represents a requirement which is not required in any other undergraduate curriculum--not even curricula designed to prepare persons for careers as engineers, doctors, lawyers, etc. This is being said without attempting an argument about the relativity of grades.

7. There is disagreement with the statement (page ~~77~~ 76) that "these employers, especially the larger ones, are selecting the bachelors-educated person with no data processing (computer science) knowledge over the two-year technically-oriented person." Such a statement is certainly not supported by experiences in the Tidewater area.

8. Unsubstantiated and largely subjective views of adjunct faculty have no place within this report. There are no data which were submitted by any community college which would support most of the comments which were presented.

9. The first recommendation which appears on page ~~91~~ 90 is very puzzling. The Task Force appears to be unaware that the Virginia Community College System has already selected the computer technology/system architecture considered best able to meet its needs. Regional academic computing centers are already in place and are providing academic support to the various colleges. IBM 4341 mainframes are in place and, after a shaky start-up period, are adequately providing instruction to thousands of community college students. The Task Force recommendation that an immediate and thorough review be conducted before Fall 1983 is not at all reasonable.

There are other statements and conclusions with which there is not total agreement--and that is to be expected with any report--but the right of the Task Force to exercise its judgment and present its findings is recognized and respected. All in all, the report is a fair assessment and many of the recommendations will be of value to the VCCS and its individual institutions.

The magnitude of the Task Force's efforts is impressive and all who have worked so hard throughout the entire project are to be commended.

Again, thank you for the opportunity to review the final report.

Sincerely,

Robert J. Grymes, Jr.
Dean-Instructional and
Student Services

RJGjr/aw

VIRGINIA WESTERN COMMUNITY COLLEGE
3095 Colonial Avenue, S.W., P.O. Box 14045, Roanoke, Virginia 24038. Phone: 703/982-7313

DEAN OF INSTRUCTION

MEMORANDUM

TO: W. Thrombley

FROM: Paul T. Pullen, Dean of Instruction

DATE: August 31, 1983

SUBJECT: Virginia Western Community College Response to Task Force Report on Computer Science

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Draft Report - An Assessment of Computer Science Degree Program in Virginia

The Task Force is to be commended for its forward looking, thorough, and comprehensive report. A vast number of the recommendations are in the process of being implemented at Virginia Western Community College; however, severe budget limitations have slowed progress. Virginia Western Community College is sympathetic to selective admission to this curriculum; however, predictors of success have not proved reliable and valid at this point.

PTP/dg

cc: Dr. Charles L. Downs, President
Dr. Charles Houston
Dr. Andrew Archer
Mr. Carroll Gentry
Dr. Elmo Roessler

Wytheville Community College, 1000 East Main Street, Wytheville, Virginia 24382, Telephone 703/228-5541

MEMORANDUM

TO: Gordon K. Davies, Director
State Council of Higher Education for Virginia

FROM: Leonard F. O'Hara
Dean of Instruction

DATE: August 24, 1983

RE: WCC Response to the SCHEV Task Force
Report on Computer Science

Wytheville Community College recommends that the Task Force Report be approved. We do so with the understanding that appropriate debate and deliberation will occur prior to the institution of substantive changes in direction or philosophy.

No doubt, the report contains minor errors of fact which, if corrected, might increase its purity. However, we believe that it would be counterproductive to haggle over trivia while the major conclusions regarding the direction and quality of Virginia's Computer Science offerings ring true.

Viewed holistically, the report is a good one — it should lead to positive reforms.

LO

LO/tf

cc: Dr. Elmo Roesler, Director
Planning and Evaluation, VCCS
✓Dr. John E. Molnar, Co-Chairman
Task Force on Computer Science
Dr. William F. Snyder, President
Wytheville Community College